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EFFECTS OF WINTER NAVIGATION ON WATERFOUL AND RAPTORS
IN THE ST MARY'S RIVER AREA(U) NORTHERN MICHIGAN UNIV
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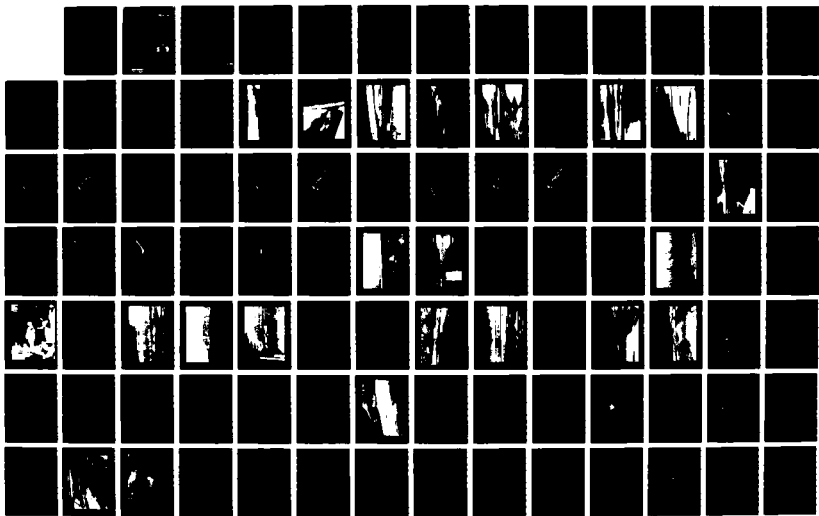
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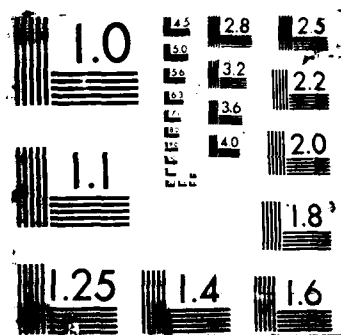
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EFFECTS OF WINTER NAVIGATION ON WATERFOWL AND
RAPTORS IN THE ST. MARY'S RIVER AREA

By
W. L. Robinson
R. W. Jensen

Department of Biology
Northern Michigan University
Marquette, Michigan

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TABLE OF CONTENTS

	Page No.
SUMMARY.....	i
LIST OF FIGURES.....	ii
LIST OF TABLES.....	vi
INTRODUCTION.....	1
THE STUDY AREA.....	3
METHODS.....	6
RESULTS.....	7
PHYSICAL CONDITIONS.....	7
ICE COVER.....	7
SHIP TRAFFIC.....	38
WATERFOWL.....	42
Species Present.....	42
Mallards and Black Ducks.....	42
Canada Geese.....	48
Common Goldeneye.....	48
Common Merganser.....	48
Summary of Waterfowl Populations.....	52
Areas Used by Diving Ducks.....	52
DeTour-Drummond Island Area.....	52
Neebish Island Rock Cut.....	53
Sault Ste. Marie Area.....	53
Impacts of Winter Shipping on Waterfowl.....	60
Direct Effects.....	60
Potential Effects.....	66
RAPTORS.....	69
Snowy Owls.....	69
Eagles.....	69
Numbers, Dates Seen, and Areas Used.....	69
Eagle Home Range.....	80
Eagle Food Habits.....	83
Eagle Capture Attempts.....	83
Other Raptors.....	83
Impacts of Ships and Humans on Eagles.....	88
Direct Effects.....	88
Potential Effects.....	89
EFFECTS OF ICE BOOMS AND BUBBLERS.....	90
CONCLUSIONS AND RECOMMENDATIONS.....	91
CRITICAL AREAS.....	91
Waterfowl.....	91
Raptors.....	91
RECOMMENDATIONS.....	97
LITERATURE CITED.....	99
APPENDIX.....	102



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SUMMARY

From January through April of 1979 and 1980, waterfowl and raptors wintering in the St. Mary's River-Whitefish Bay area were observed to determine the effects of winter navigation on these birds. Commercial shipping occurred through the winter of 1978-79, but was suspended from 15 January-24 March 1980. About 1000 waterfowl wintered in the area with the mallard, common goldeneye, and common merganser being the most common species. The raptors seen most frequently near the river were a pair of bald eagles and an occasional snowy owl.

Critical areas for waterfowl include the St. Mary's Falls, the Edison Soo Hydro outfall, and the open water along the Canadian shore at Sault Ste. Marie and in the North Channel, especially the Sault, Ontario sewage treatment plant. Critical areas for eagles include the North Channel area and north Sugar Island. Other areas for both groups may also be critical, but are not easily identified or defined.

Waterfowl and raptor behavior was affected by ship passage, with both groups largely avoiding the ship channel when shipping was in progress, but using areas in and near the channel in the absence of shipping. Direct impacts of ships on waterfowl and raptors did not appear to be acute, as avian mortality on the study area was negligible during both winters.

A potentially serious impact on the birds would be the spillage of oil or other toxic substances. Indirect or chronic impacts which were not assessed include: increased turbidity of river water, reducing duck food productivity and availability; scouring of shore vegetation reducing waterfowl reproductive habitat; ship traffic depriving eagles of critical habitat or areas which have not yet been identified as such. *(regarding environmental impact + J(KT))*

Recommendations include continued study, especially the gathering of more data in the absence of winter shipping for baseline purposes; or if winter shipping proceeds, to closely monitor avian populations and behavior, watching for any negative impacts. Hours of ship traffic might be regulated so as to reduce disturbances to waterfowl and especially to eagles.

LIST OF FIGURES

<u>Figure</u>		<u>Page No.</u>
1	Lake Superior region. St. Mary's River-Whitefish Bay study area on the right.....	4
2	Map of St. Mary's River-Whitefish Bay study area.....	5
3	St. Mary's River looking northeast toward Johnson Point. Ship track visible at left. 13 February 1979.....	9
4	Neebish Island Rock Cut looking upriver. 3 April 1979.	10
5	Open water between Sugar and East Neebish Islands. 10 March 1979.....	11
6	The Ice Breaker Naugatuck maintaining a channel for the Drummond Island Ferry. 13 February 1979.....	12
7	The DeTour Passage looking north. 10 March 1979.....	13
8	Pointe aux Pins looking west. 16 February 1980.....	15
9	Pointe aux Pins looking west. 16 April 1979.....	16
10	Map showing open water at Sault Ste. Marie on 23 January 1980.....	17
11	Map showing open water at Little Rapids Cut and North Channel on 23 January 1980.....	18
12	Map showing open water at Sault Ste. Marie on 13 February 1979.....	19
13	Map showing open water at Sault Ste. Marie on 16 February 1980.....	20
14	Map showing open water at Little Rapids Cut and North Channel on 13 February 1979.....	21
15	Map showing open water at Little Rapids Cut and North Channel on 16 February 1980.....	22
16	Map showing open water at Sault Ste. Marie on 10 March 1979.....	23

LIST OF FIGURES

<u>Figure</u>		<u>Page No.</u>
17	Map showing open water at Sault Ste. Marie on 14 March 1980.....	24
18	Map showing open water at Little Rapids Cut and North Channel on 10 March 1979.....	25
19	Map showing open water at Little Rapids Cut and North Channel on 14 March 1980.....	26
20	Map showing open water at Sault Ste. Marie on 16 April 1979.....	27
21	Map showing open water at Sault Ste. Marie on 14 April 1980.....	28
22	Map showing open water at Little Rapids Cut and North Channel on 16 April 1979.....	29
23	Map showing open water at Little Rpaids Cut and North Channel on 14 April 1980.....	30
24	St. Mary's River at Sault Ste. Marie looking southeast. Maximum ice coverage. 17 February 1979.....	31
25	Map showing open water at DeTour Passage on 11 January 1979.....	32
26	Map showing open water at DeTour Passage on 19 January 1979.....	33
27	Map showing open water at DeTour Passage on 16 April 1979.....	34
28	Map showing open water at DeTour Passage on 23 January 1980.....	35
29	Map showing open water at DeTour Passage on 2 February 1980.....	36
30	Map showing open water at DeTour Passage on 15 March 1980.....	37
31	The ore carrier Stinson moving upriver through heavy ice. 16 February 1979.....	39
32	The ore carrier Arthur M. Anderson downbound at head of Little Rapids Cut. 21 March 1979.....	40

LIST OF FIGURES

<u>Figure</u>		<u>Page No.</u>
33	Snow goose (dark phase) and Canada goose at Sault, Ontario Country Club. 3 April 1979.....	44
34	Population estimates of mallards and black ducks, common goldeneyes, common mergansers, and Canada geese on the study area, Jan.-Apr. 1979.....	45
35	Population estimates of mallards and black ducks, common goldeneyes, and common mergansers on the study area, Jan.-Apr. 1980.....	46
36	Mallards being fed at Bellevue Park, Sault Ste. Marie, Ontario. 17 February 1979.....	47
37	Thirteen of the flock of 14 Canada geese at Bellevue Park, Sault Ste. Marie, Ontario. 21 March 1979.....	49
38	Flock of common goldeneyes near the Canadian shore of the North Channel. 14 February 1980.....	50
39	A pair of common mergansers near the Sugar Island Ferry crossing. 3 April 1979.....	51
40	The Edison Soo Hydro outfall. 16 February 1980.....	54
41	The St. Mary's Falls. A favorite goldeneye feeding spot. 13 February 1979.....	55
42	The North Channel east of Sault Ste. Marie, looking west. 10 March 1980.....	57
43	The Little Rapids Cut looking north. Islands 1-4 at center. 16 April 1979.....	58
44	Greater scaup in the water outside Bellevue Park, Sault Ste. Marie, Ontario. 13 April 1980.....	59
45	The effect of passage of the ore carrier Grosbrenner on ducks flying near Izaak Walton Bay. 13 April 1979.	61
46	The effect of passage of the ore carrier Dykstra on ducks flying near Izaak Walton Bay. 13 April 1979..	62
47	The effect of passage of the ore carrier Block on ducks flying near the south end of the Little Rapids Cut. 17 April 1979.....	63

LIST OF FIGURES

<u>Figure</u>		<u>Page No.</u>
48	The effect of passage of the freighter New Haven on ducks flying near the south end of the Little Rapids Cut. 27 April 1979.....	64
49	The north end of the Little Rapids Cut at the Sugar Island Ferry crossing. Sugar Island in the foreground. 13 February 1979.....	67
50	The number of ships passing through the St. Mary's River versus the number of ducks per hour of observation in the ship channel.....	68
51	Adult bald eagle flying south at the head of the Little Rapids Cut. 16 March 1980.....	71
52	Locations of snowy owl sightings within 100 m of the St. Mary's River.....	73
53	Locations of favored daytime eagle perches in the Sault Ste. Marie area.....	75
54	Aerial view of eagle perch island (Perch "1"). Small island at right center surrounded by a crescent shaped area of open water. 10 March 1979.	76
55	Aerial view of Perch 1. 13 February 1979.....	77
56	Estimated eagle winter home range on the St. Mary's River.....	82
57	Locations of eagle feeding sights during the winters of 1978-79 and 1979-80.....	85
58	Adult bald eagle circling over the main channel near the head of the Little Rapids Cut. 14 March 1980.....	86
59	Critical areas for wintering waterfowl at Sault Ste. Marie.....	92
60	Critical areas for wintering waterfowl at Sault Ste. Marie.....	93
61	Sault Ste. Marie, Ont. Algoma Steel Corporation (background) produces warm water effluent.....	94
62	The area frequented by eagles during both winter study seasons (1978-79 and 1979-80).....	96

LIST OF TABLES

<u>Table</u>		<u>Page No.</u>
1	Monthly temperature and precipitation data (for January through April 1979 and 1980) for Sault Ste. Marie.....	8
2	Monthly cargo vessel transits on the St. Mary's River. 1 Jan.-15 Apr., 1979 and 1980.....	41
3	Waterfowl species present on the St. Mary's River study area during the winters of 1978-79 and 1979-80.....	43
4	The number of ducks per hour of effort observed using the ship channel for feeding or resting in 1979 and 1980.....	65
5	Raptors seen on the St. Mary's River study area during the winters of 1978-79 and 1979-80.....	70
6	Summary of observations of snowy owls within 100 m of the St. Mary's River during the winters of 1978-79 and 1979-80. Observation numbers correspond with the numbers shown on Figure 52.....	72
7	Eagle sightings per hour of effort in the field, 1979.....	78
8	Eagle sightings per hour of effort in the field, 1980.....	79
9	A comparison of the number of times that eagles were sighted flying with sightings of eagles perched in 1979 and 1980.....	81
10	The numbers of times eagles were sighted within $\frac{1}{2}$ mile (0.8 km) of the ship channel and more than $\frac{1}{2}$ mile from the ship channel in 1979 and 1980.....	81
11	Summary of observations of eagles feeding during the winters of 1978-79 and 1979-80. Observation numbers correspond with the numbers on Figure 57..	84

INTRODUCTION

Since 1971 shipping during the winter months has proceeded in the St. Mary's River and Whitefish Bay of Lake Superior under authorization of Section 197 of Public Law 91-611, the "Rivers and Harbors Act of 1970" and subsequent enabling legislation. The primary objective of the legislation has been to demonstrate the practicability of extending the navigation season on the Great Lakes - St. Lawrence Seaway. Among numerous potential environmental influences of winter navigation are its effects on birds which use the rivers and bays through which the ships pass.

Winter for many birds is a critical period. Cold temperatures, winds, snow, and frequent scarcity of food create metabolic demands which may be reflected in direct mortality or reduced reproductive success the following spring.

Some waterfowl may winter wherever open water is available and they are known to be encouraged to stay farther north than they normally would by man-made conditions such as open water created by thermal discharges from power plants and manufacturing (Nelson 1967) or by providing food (Sugden et al. 1974). Under such conditions mortality rates may be high because of cold temperatures or depletion of natural food supplies, or oil spills. Such high mortality has happened often in the Detroit River among wintering populations of canvasbacks (*Aythya valisneria*), redheads (*A. americana*), and scaup (*A. marila*) (U.S. Army Corps of Engineers 1977).

A few predatory birds or raptors are associated with water. Among these are the bald eagle (*Haliaeetus leucocephalus*), and osprey (*Pandion haliaetus*), which are fish eaters and the peregrine falcon (*Falco peregrinus*) and gyrfalcon (*Falco rusticolus*) which prey upon aquatic birds.

Several species of waterfowl and a few species of raptors, including the bald eagle, which is designated under the Federal Endangered Species Act as a threatened species in Michigan, inhabit the St. Mary's River-Whitefish Bay area in the winter. Studies have been done to describe waterfowl populations in the Detroit River area (U.S. Army Corps of Engineers 1977), and on waterfowl and raptors in the upper St. Lawrence River (Maxwell and Smith 1978) and to assess some potential effects of winter navigation on these birds. There has been, however, no systematically gathered quantitative information on winter bird populations occupying the St. Mary's River- Whitefish Bay area and the impact of winter navigation on these populations.

Potential impacts might include:

1. The maintenance of open water which could encourage birds to remain farther north than where they might normally winter at some metabolic cost.
2. Ducks wintering in restricted open water areas created by shipping might deplete available food supplies.

3. The passage of ships might flush birds and cause the expenditure of energy by the birds which might otherwise be conserved.

4. Ship passage may elicit changes in behavior and movement patterns of waterfowl and/or raptors.

5. Indirect effects of winter shipping include such factors as increased turbidity and ice scouring affecting productivity of duck food organisms and spillage of oil or toxic materials brought about by increased risk of ship damage could affect ducks and eagles and their food supplies.

The objectives of this study were:

1. To describe the species and numbers of waterfowl using the study area in winter.

2. To describe the numbers and species of raptors using the study area.

3. To develop a map designating areas within the study area used by birds and indicating frequencies of use, time and season of use, type of use, such as feeding, resting or courtship.

4. To describe winter resident populations and migrating populations and time of migration.

5. To take photographs of important portions of the study area and of birds using them, where possible.

6. To analyse the effects of winter navigation, such as maintaining open channels, ice booms, and bubblers on waterfowl and raptor populations.

7. To analyse the immediate impact of passing vessels on the movements of waterfowl and raptors.

8. To make recommendations for reducing or eliminating possible negative impacts upon waterfowl and raptor populations and behavior in the study area.

THE STUDY AREA

The study area for the winters of 1979 and 1980 was Whitefish Bay of Lake Superior and the entire St. Mary's River, which connects Lakes Superior and Huron (Figures 1 and 2). Efforts were concentrated on the St. Mary's River portion of the area, because Whitefish Bay froze over and remained ice covered during the study periods of both winters, while portions of the river remained open through the winter serving as resting and feeding areas for waterfowl and as potential feeding sites for raptors.

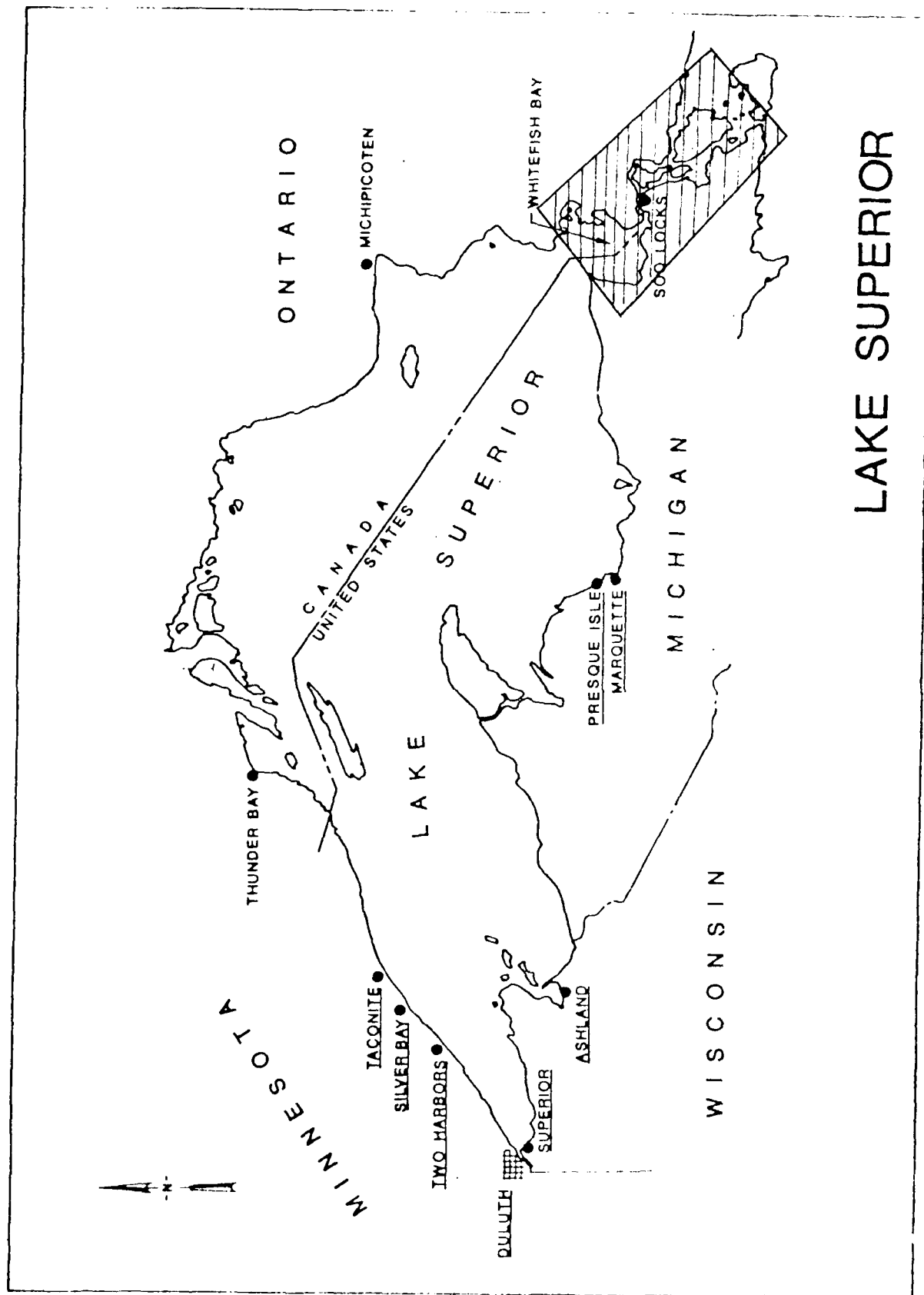
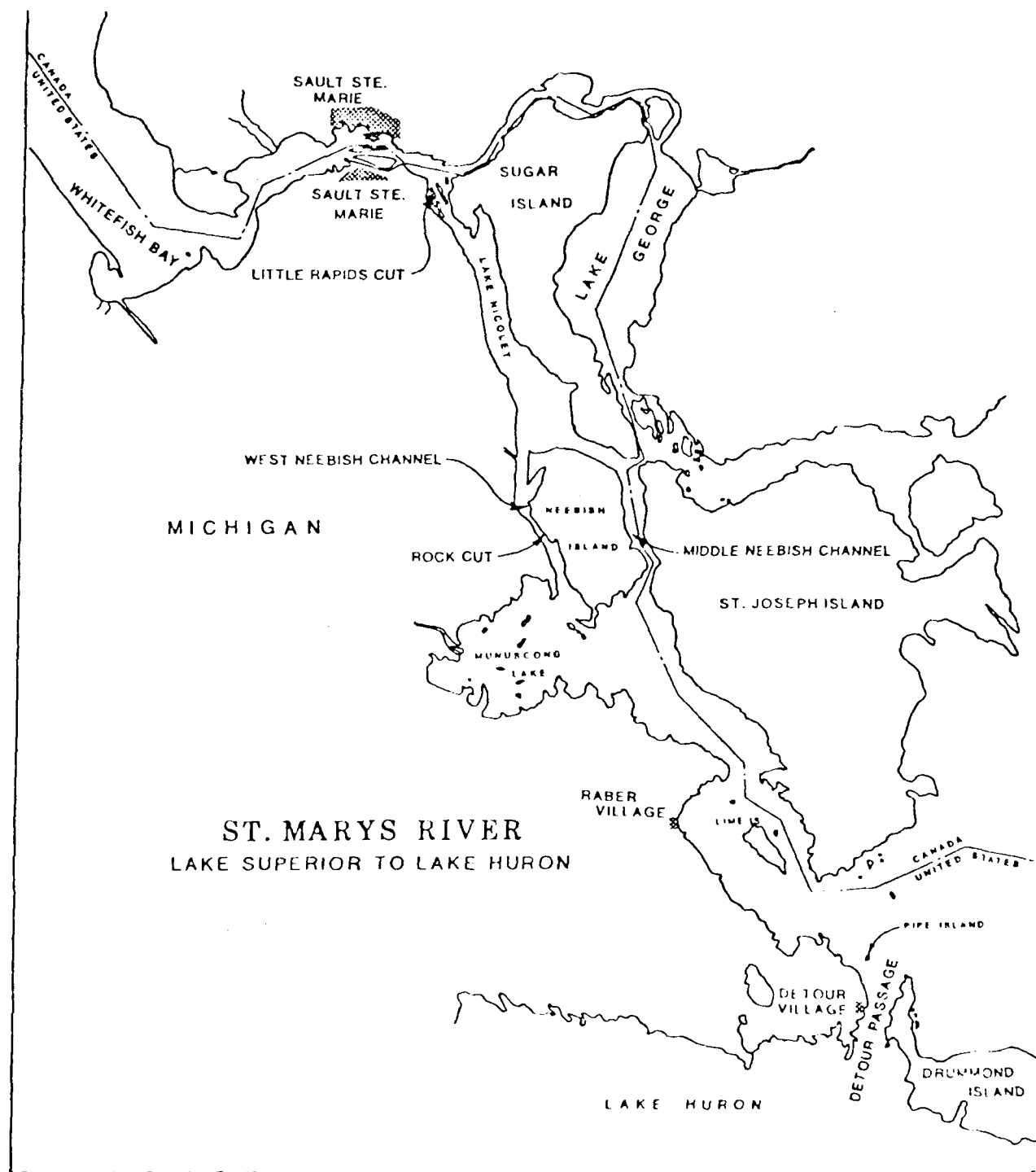
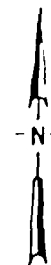


Figure 1. Lake Superior Region. St. Mary's River-Whitefish Bay study area on the right.

Figure 2. Map of St. Mary's River-Whitefish Bay study area.



METHODS

During 1979, field observations began on 11 January and continued through 30 April, during which time 60 days (81 person-days by Graduate Assistant Ronald W. Jensen and Project Supervisor William L. Robinson) were spent making ground observations, 9 days making aerial observations, and 1 day observing from on board the U. S. Coast Guard Cutter Mackinaw.

During 1980, observations began on 27 December and continued through 25 April. Sixty-six days were spent in the field (one hundred three person-days by Jensen and Robinson with assistance from Student Intern John Huff and Research Associate Todd Fuller). Six aerial surveys were conducted; 4 days were spent by Jensen in attending a bald eagle conference in St. Paul, Minnesota; 4 days were spent in travel and presenting research results to the Michigan Academy of Arts, Sciences, and Letters in Detroit, Michigan.

Ground observations were made from 20 locations (Appendix 1), all but a few of which were accessible by automobile. Equipment used included 7 x 35 and 7 x 50 binoculars, and a 20x spotting telescope with tripod. Photographs were taken using a single lens reflex 35 mm camera with a 40-205 mm zoom lens and a 2x converter. A cassette tape recorder was used for making field notes concerning time, weather conditions, numbers of birds seen, species, sex ratios, and behavioral activities.

In 1979, aerial surveys were conducted on 11, 19, and 26 January, 5, 13, and 17 February, 10 March, and on 3 and 16 April, using a Cessna 3-172 aircraft contracted with Chippewa Flying Service and piloted by Robert Augustine. Altitudes varied from 400-1000 feet.

During 1980, aerial surveys were flown on 23 and 31 January, 16 February, 1 and 15 March, and on 25 April, using a Piper Super Cub PA 11 aircraft fitted with skis, and piloted by Ron Scout or Ernie Gulyas of Algoma Airways. Altitudes varied from 100-1000 feet. Information recorded during both seasons included extent of ice coverage, location of groups of ducks (and species where possible), and location and behavior of eagles when they could be found.

In the 1980 study season, an attempt was made, under permit from the U. S. Fish and Wildlife Service, to capture one or both of the bald eagles using the study area, in order to band and attach radio transmitters to the birds, so that their hourly movements could be monitored. Three types of traps were employed. A deer carcass was fitted with about 100 nooses of monofilament line and placed on the ice. Second, a drake domestic mallard duck was skinned out, and a no. 1½ steel jump trap with padded jaws placed inside and camouflaged with feathers. These two methods were suggested by Tom Dunstan, University of Illinois (personal communication). Lastly, a 10 inch (25 cm) whitefish was gutted, filled with a styrofoam plug and rigged with an open monofilament noose snare. This technique had been used successfully by Fred Robards (U. S. Fish and Wildlife Service, retired) in Alaska (personal communication).

RESULTS

PHYSICAL CONDITIONS

Data obtained from the National Weather Service in Sault Ste. Marie, Michigan indicated that the winter of 1978-79 was more severe than normal (normal statistics based on years 1941-1970), with temperatures lower than usual and precipitation greater (Table 1). While March and April temperatures in 1979 were near normal, the January average temperature was 5.3°F (2.93°C) below the normal January average and the February 1979 average temperature was 10.0°F (5.57°C) below normal. As a result, ice cover was extensive in those months. The temperatures during the winter of 1979-80 were much nearer normal, and precipitation while above normal in January, was below normal in February and March.

ICE COVER

In spite of the difference in temperatures, the St. Mary's River remained 90-95% ice covered from mid-January to early March during both winters of study (Figure 3). Whitefish Bay remained ice covered during this period also. The surface area of the St. Mary's River from Whitefish Bay to Lake Huron is approximately 283 km^2 (109 mi^2). (The river's outer boundaries encompass some 392 km^2 and the major islands have a surface area of about 109 km^2 .) The greatest area of open water on the river was in the vicinity of Sault Ste. Marie. The river's surface area from the Sault Locks to Little Lake George in the North Channel and to the north end of Lake Nicolet (below the Little Rapids Cut in the main channel) is about 10 km^2 or only about 4% of the river's total area. During maximum ice coverage in February 1979, it is safe to say that the river was 98-99% ice covered. Ice conditions near Sault Ste. Marie and the DeTour Passage at representative times through the winters of study are shown in Figures 4 through 30. As mentioned, Whitefish Bay was frozen all during both study seasons (except in early January 1980), as was most of the river between the Little Rapids Cut and the DeTour Passage, and all points beyond the Canadian sewage treatment plant with only two exceptions. One was the Rock Cut between Neebish Island and the Michigan mainland (Figure 4). The other was a horseshoe shaped patch of water about $1/2$ by $1/3\text{ km}$ between East Neebish and Sugar Islands (Figure 5). The amount of open water in the DeTour Passage was very changeable, depending on temperature, wind direction, and ship traffic (Figures 6 and 7).

The river above the Sault Locks to Whitefish Bay was also frozen or covered with loose ice for most of both winters. During 1980, there was

Table 1. Monthly Temperature and Precipitation Data, January-April, 1979 and 1980 from the National Weather Service, Sault Ste. Marie, Michigan.

Month	Normal Mean	1979		1980	
		Mean	Extremes High/Low	Mean	Extremes High/Low
January	-9.90	-12.83	-5.56/-28.33	-9.44	6.67/-25.56
February	-9.33	-14.90	6.11/-37.22	-10.89	2.22/-27.22
March	-4.44	-2.72	6.11/-19.44	-5.28	12.22/-25.00
April	3.44	2.78	23.33/-11.67	5.17	23.89/-8.89
	Normal	1979		1980	
January	4.88		4.72		8.69
February	3.76		4.93		2.08
March	4.42		11.68		2.90
April	5.64		9.63		8.76

Total
Precipitation
(Water equiv-
alent in cm.)



Figure 3. St. Mary's River looking northeast toward Johnson Point. Ship track visible at left.
13 February 1979.



Figure 4. Neebish Island Rock Cut looking upriver. 3 April 1979.



Figure 5. Open water between Sugar and East Neebish Islands. 10 March 1979.



Figure 6. The Ice Breaker Naugatuck maintaining a channel for the Drummond Island Ferry. 13 February 1979.



Figure 7. The DeTour Passage looking north. 10 March 1979.

open water off Pointe aux Pins (Figures 8 and 9) all winter ranging from 1 x 1/2 miles (1.6 x 0.8 km) to 4 x 1 miles (6.4 x 1.6 km) in length and width, but this area was not used by waterfowl.

The Edison Soo Hydro power canal and the Algoma Steel-Abitibi Paper power canal were both free of ice during all of both winters, but these areas were also not used by waterfowl.

The section of the St. Mary's River from the International Bridge to just below the Little Rapids Cut, and down the North Channel to the Sault, Ontario sewage treatment plant was the area in which most open water was present, and which was frequented most by ducks and raptors. Unfortunately, ice conditions in January 1979 were not photographed and consequently no maps were prepared. The other maps in Figures 10 through 23 however, show conditions on comparable dates during the two study seasons. The ice cover was more extensive in 1979, especially during February. There was always open water extending from the St. Mary's Rapids to the head of the Little Rapids Cut and was most constricted during February 1979 (Figures 12, 14, and 24) when the open channel was restricted to the shipping lane and was only 15-20 meters wide at some places.

Since there was more open water in 1980 when there was no shipping than in 1979 when there was shipping, open water is a result of warmer temperatures and warm water effluents, currents and upwellings rather than of ship traffic. Ship passage alone appears to have little if any influence on maintaining open water areas except for an hour or two immediately after passage of a ship and possibly at the upper and lower ends of the river, in early and late winter when surface temperatures are about 0° C.

Figures 25-30 show the erratic behavior of the ice cover at the DeTour Passage. The amount of ice there in 1979 was totally unpredictable and depended on temperature, wind direction, and vessel traffic which would break away ice and allow it to float out into Lake Huron. In 1980, the De-Tour Passage was completely frozen only in late February and early March. Through most of the rest of the winter, ice typically covered only the upper 1/3-1/2 of the passage, as illustrated in Figure 29, 2 February 1980.



Figure 8. Pointe aux Pins looking west. 16 February 1980.



Figure 9. Pointe aux Pins looking west. 16 April 1979.

Figure 10. Map showing open water at Sault Ste. Marie on 23 January 1980.

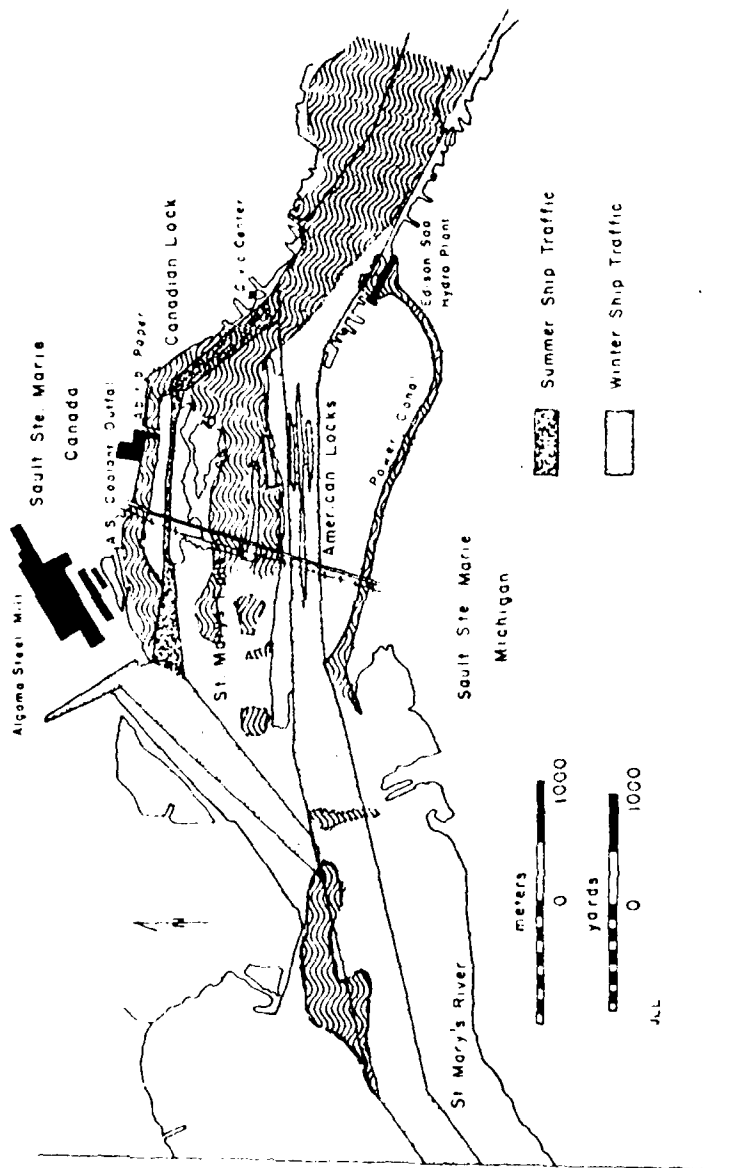


Figure 11. Map showing open water at Little Rapids Cut and North Channel on 23 January 1980.

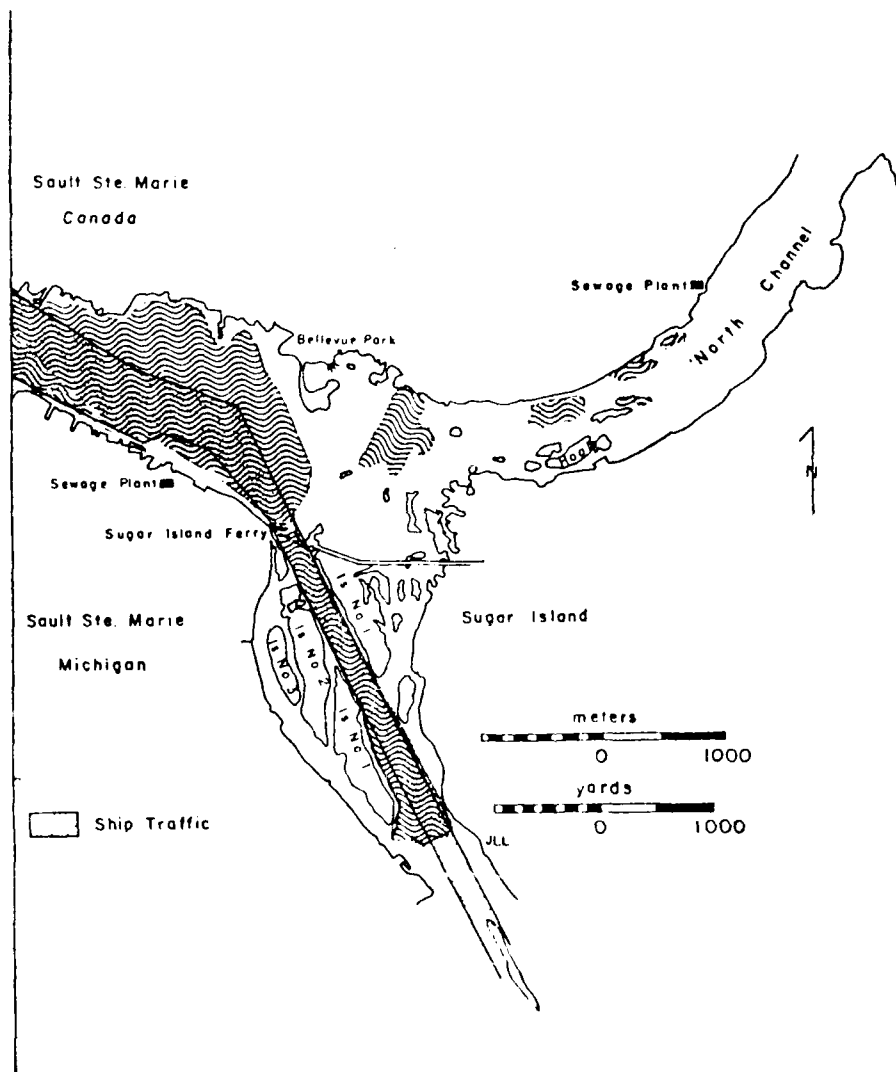


Figure 12. Map showing open water at Sault Ste. Marie on
13 February 1979.

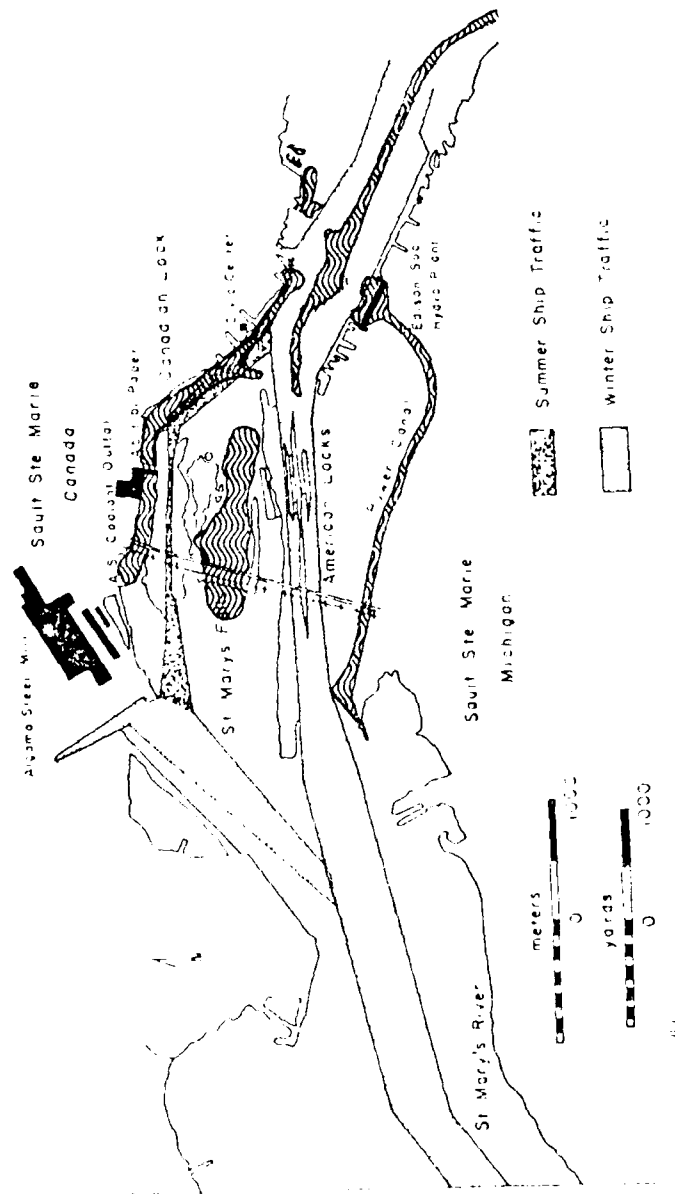


Figure 13. Map showing open water at Sault Ste. Marie on 16 February 1980.

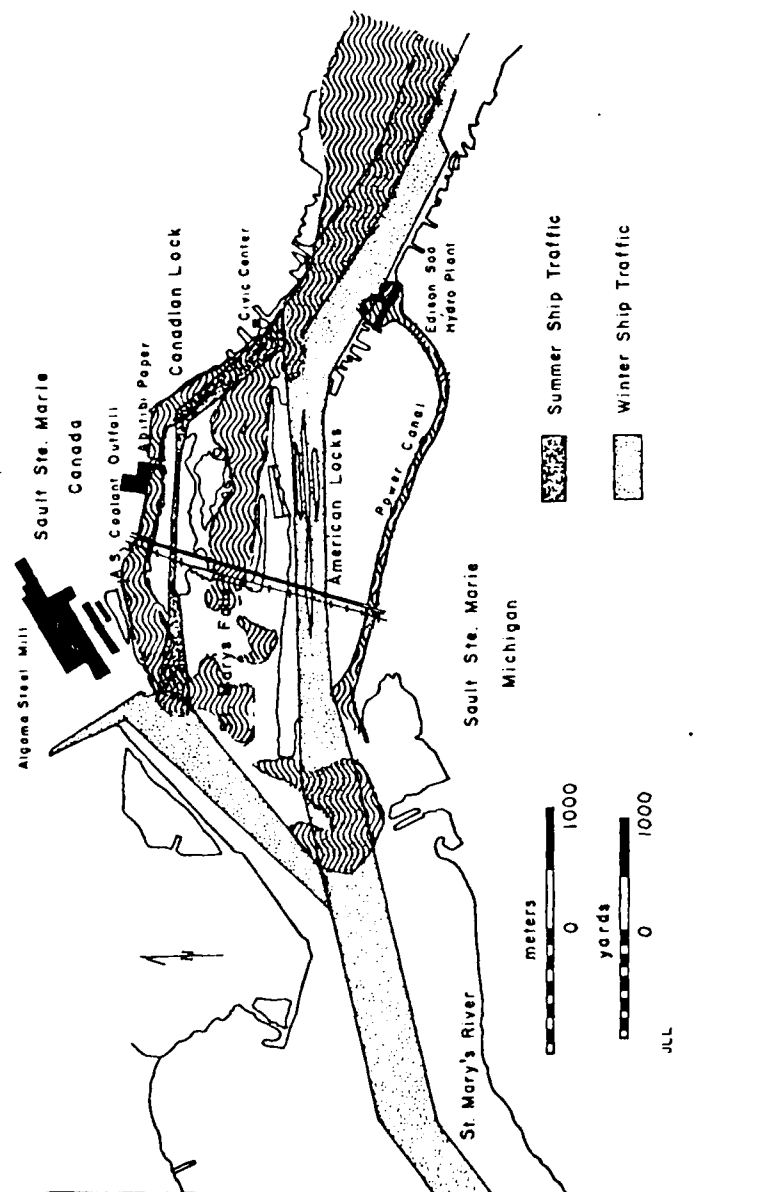


Figure 14. Map showing open water at Little Rapids Cut and North Channel, 13 February 1979.

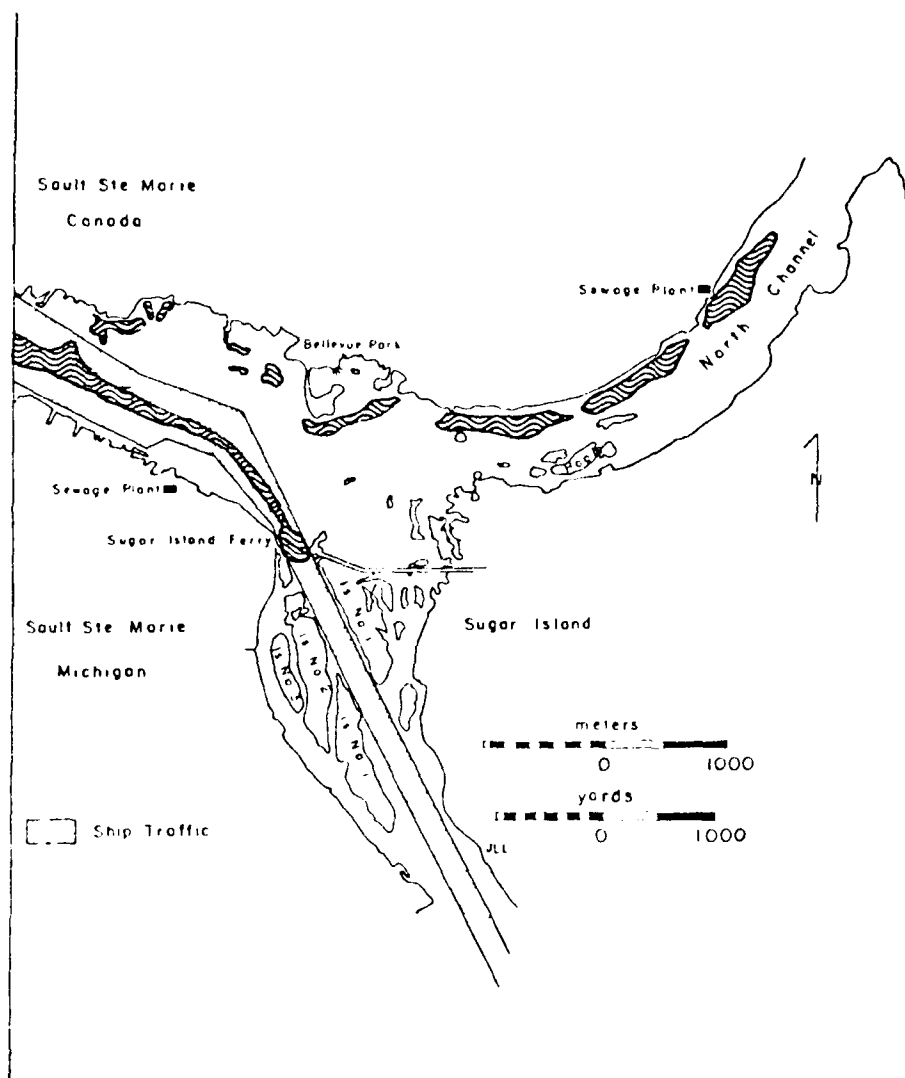


Figure 15. Map showing open water at Little Rapids Cut and North Channel on 16 February 1980.

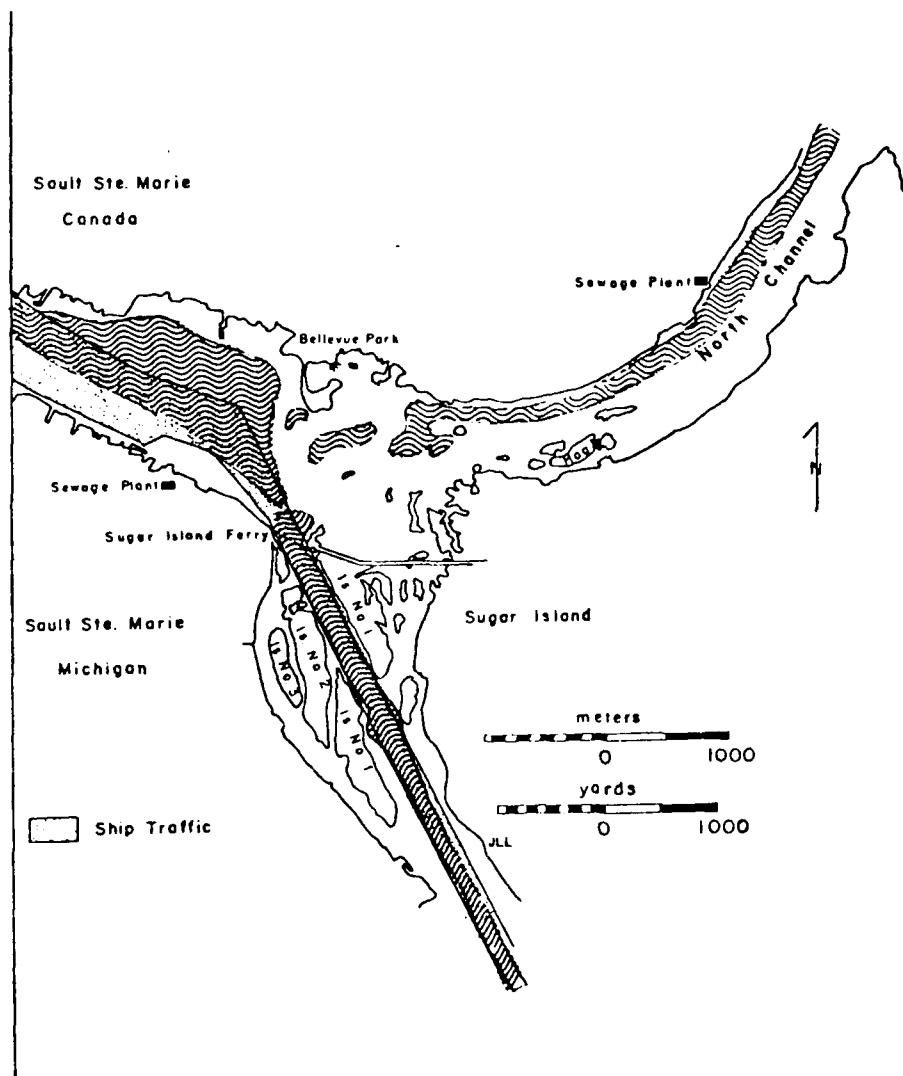


Figure 16. Map showing open water at Sault Ste. Marie on
10 March 1979.

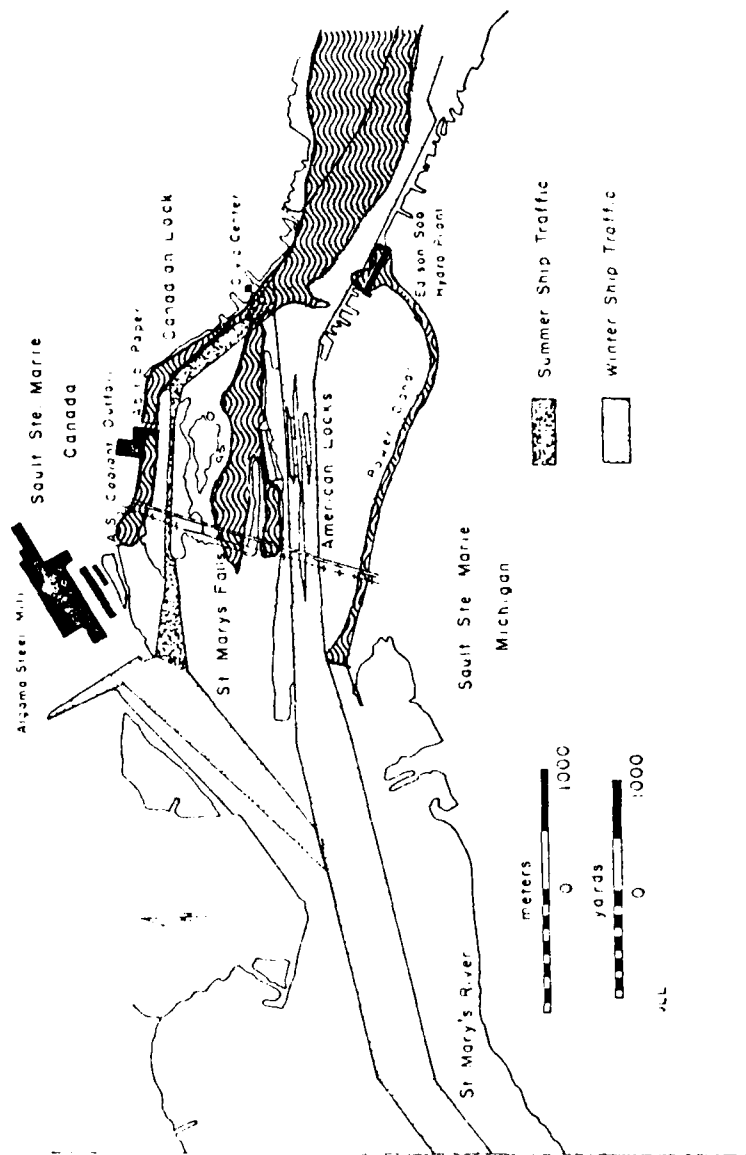


Figure 17. Map showing open water at Sault Ste. Marie on 14 March 1980.

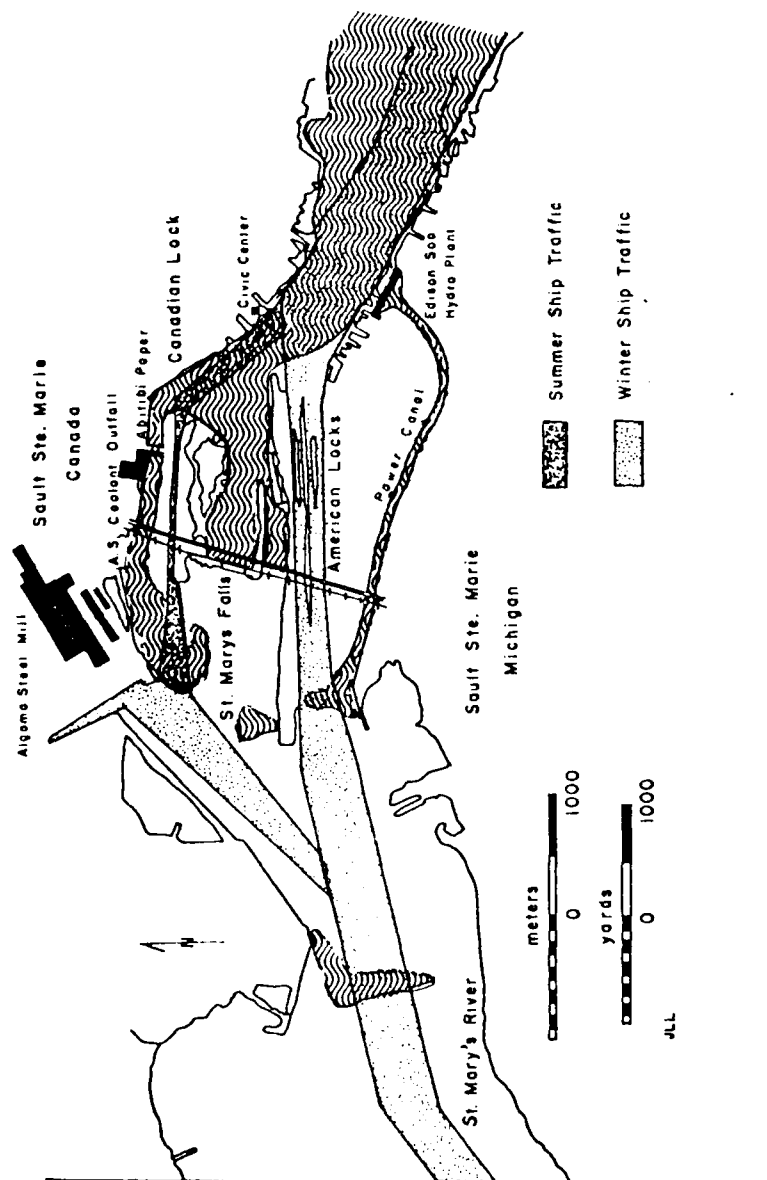


Figure 18. Map showing open water at Little Rapids Cut and North Channel 10 March, 1979.

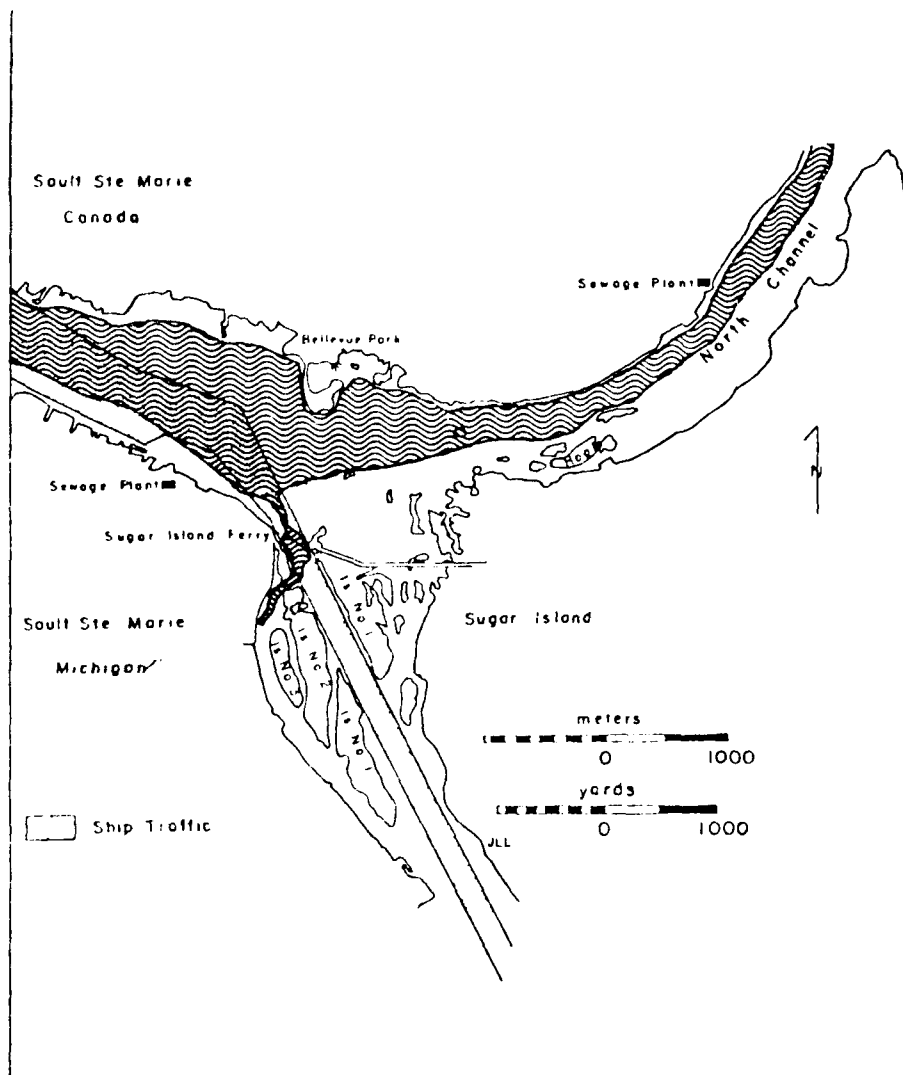


Figure 19. Map showing open water at Little Rapids Cut and North Channel on 14 March 1980.

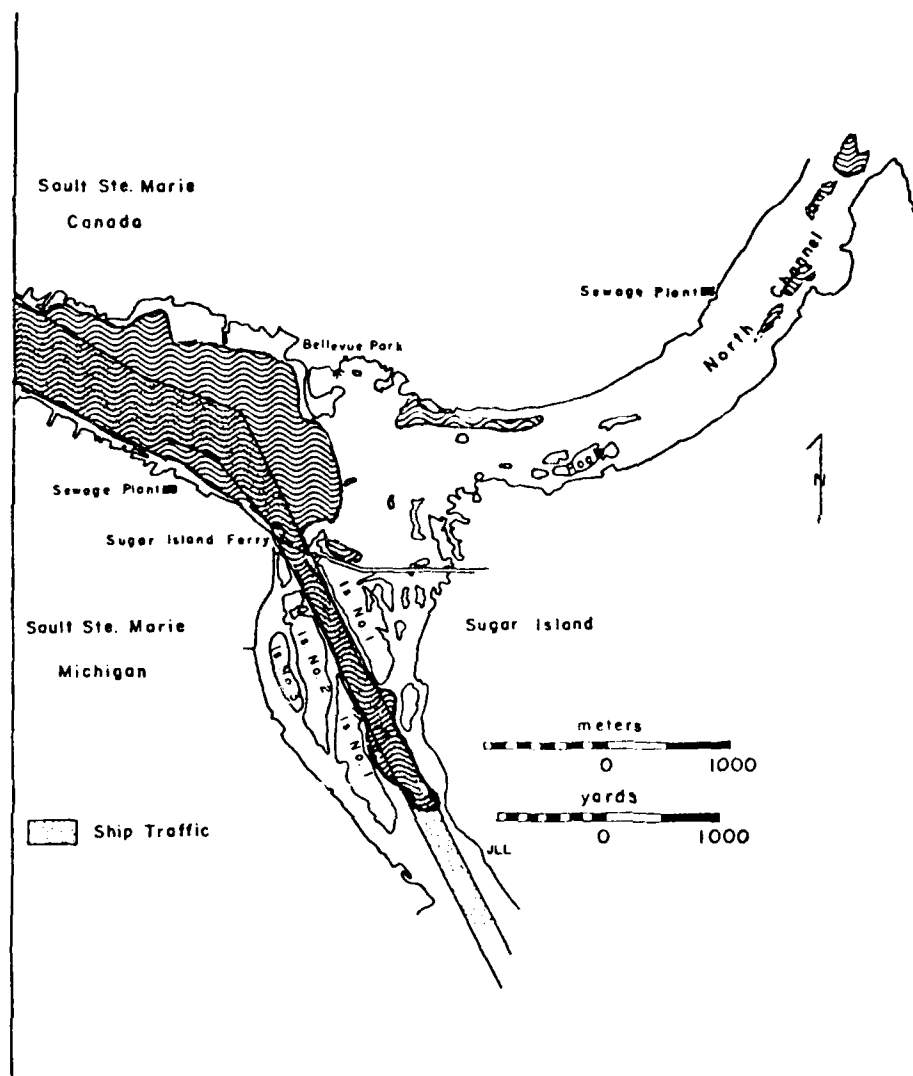


Figure 20. Map showing open water at Sault Ste. Marie on
16 April 1979.

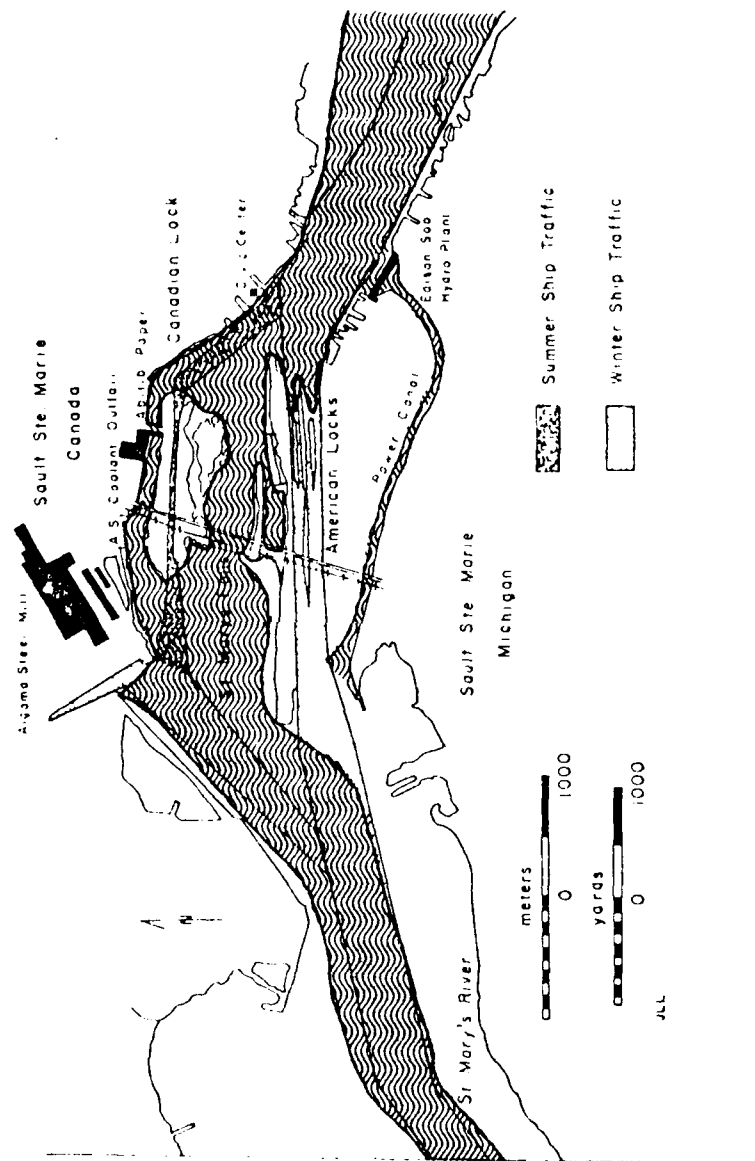


Figure 21. Map showing open water at Sault Ste. Marie on 14 April 1980.

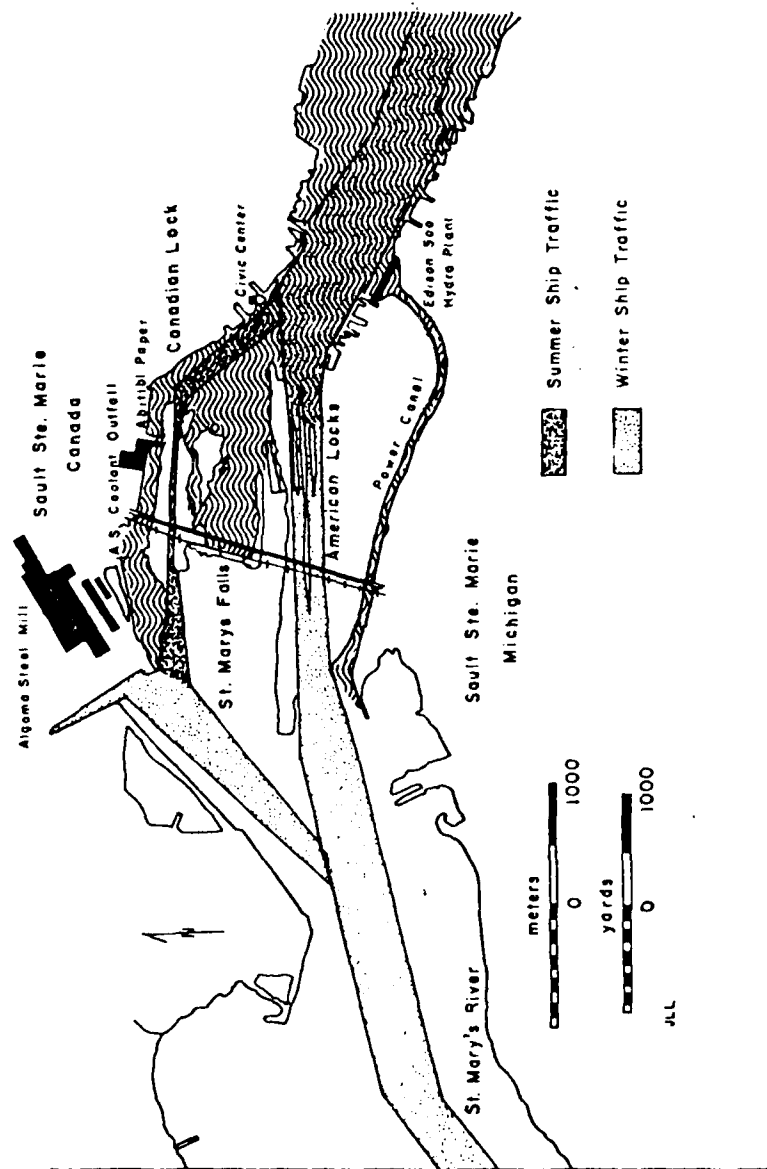


Figure 22. Map showing open water at Little Rapids Cut and North Channel, 16 April 1979.

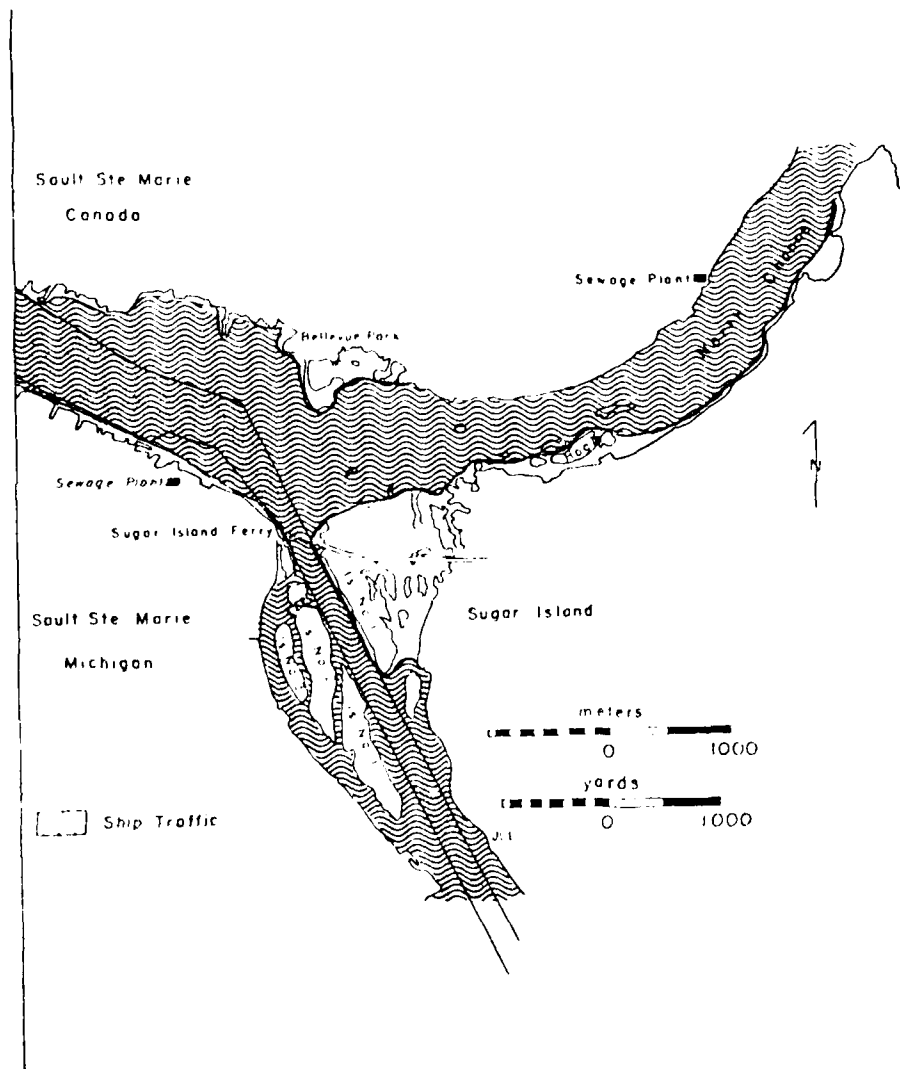


Figure 23. Map showing open water at Little Rapids Cut and North Channel on 14 April 1980.

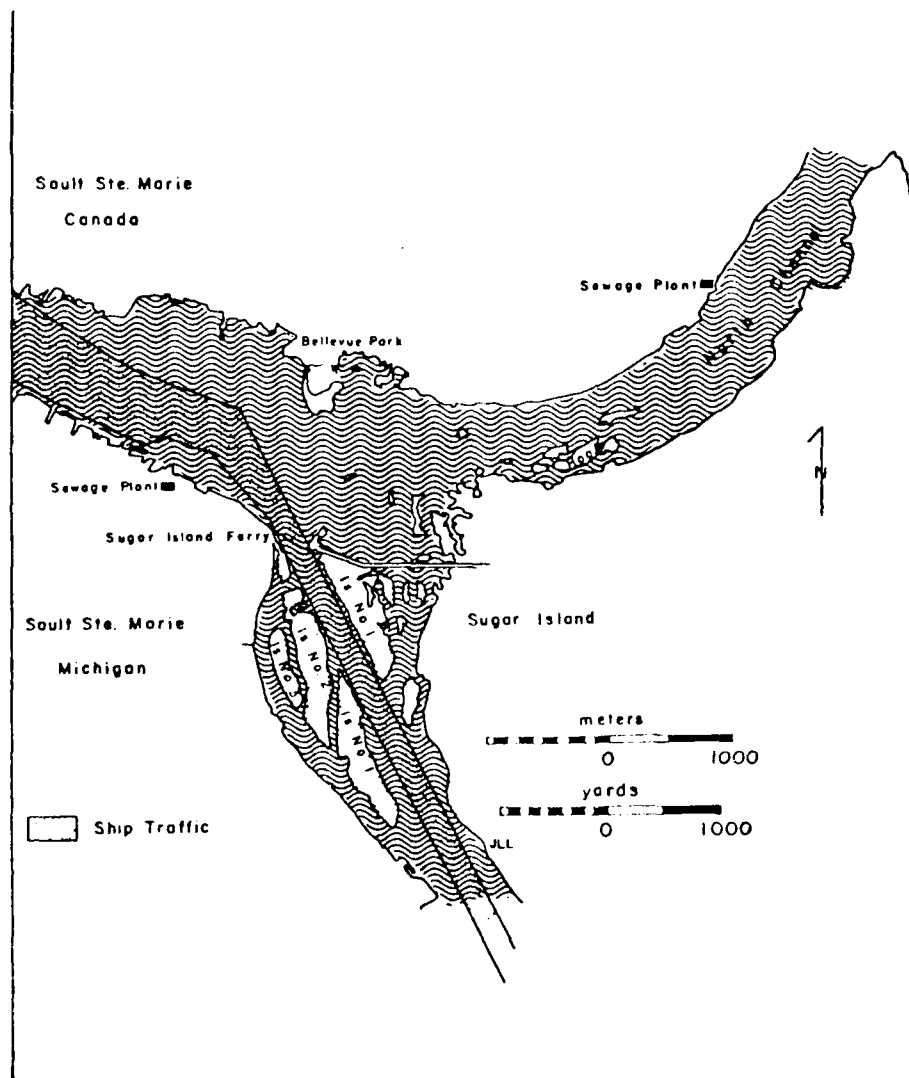




Figure 24. St. Mary's River at Sault Ste. Marie looking southeast.
Maximum ice coverage. 17 February 1979.

Figure 25. Map showing open water at DeTour Passage,
11 January 1979.

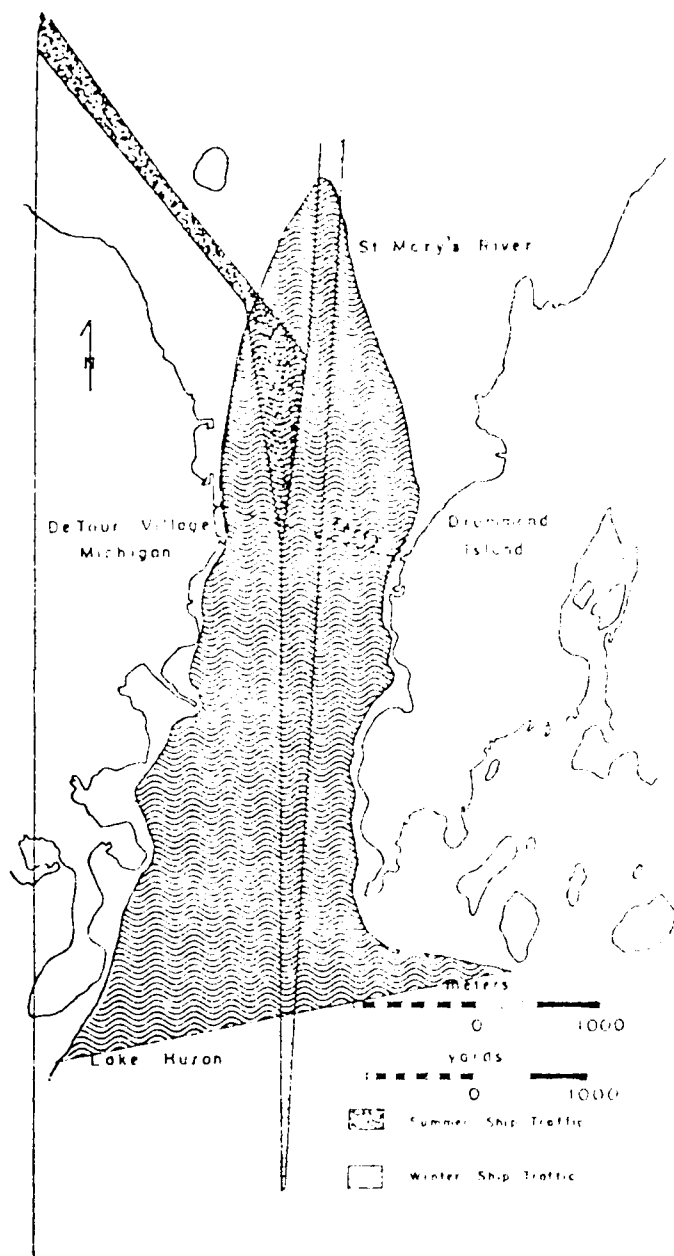


Figure 26. Map showing open water at DeTour Passage,
19 January 1979.

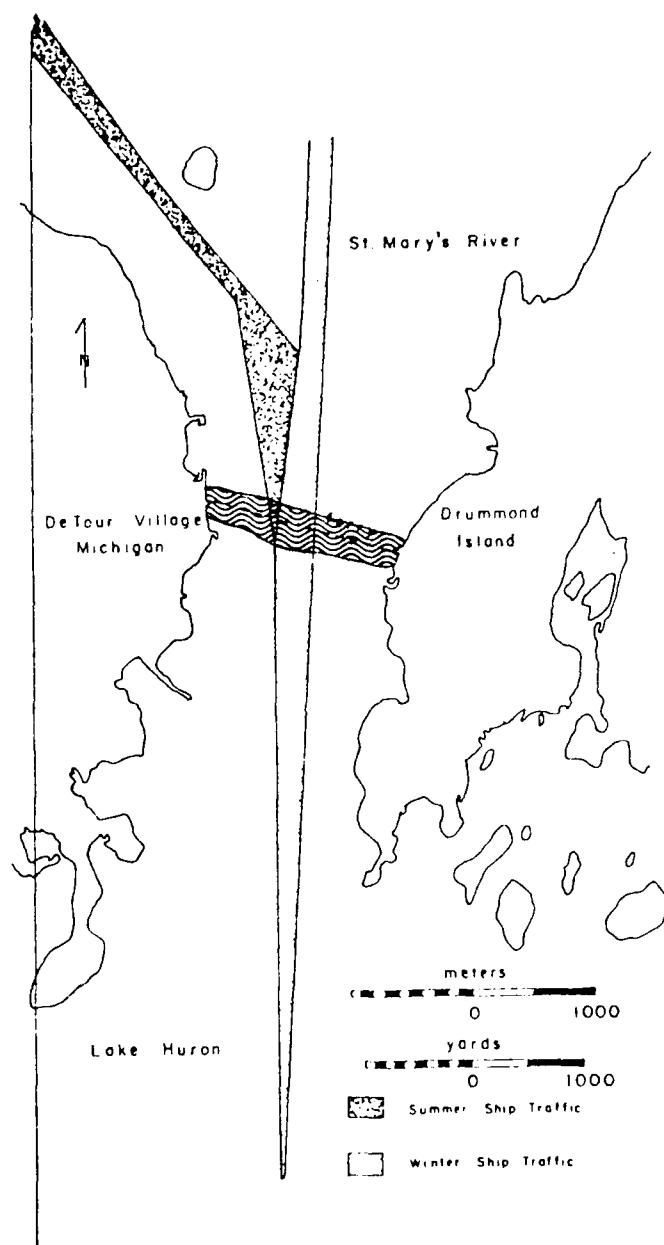


Figure 27. Map showing open water at DeTour Passage,
16 April 1979.

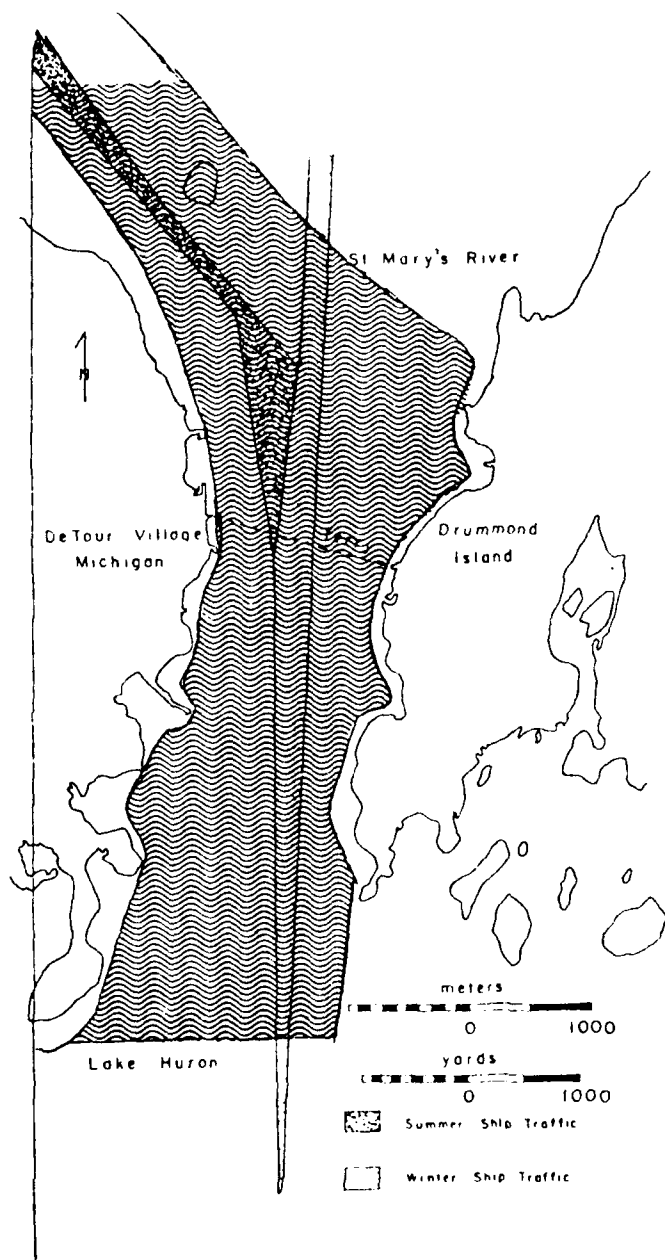


Figure 28. Map showing open water at DeTour Passage on 23 January 1980.

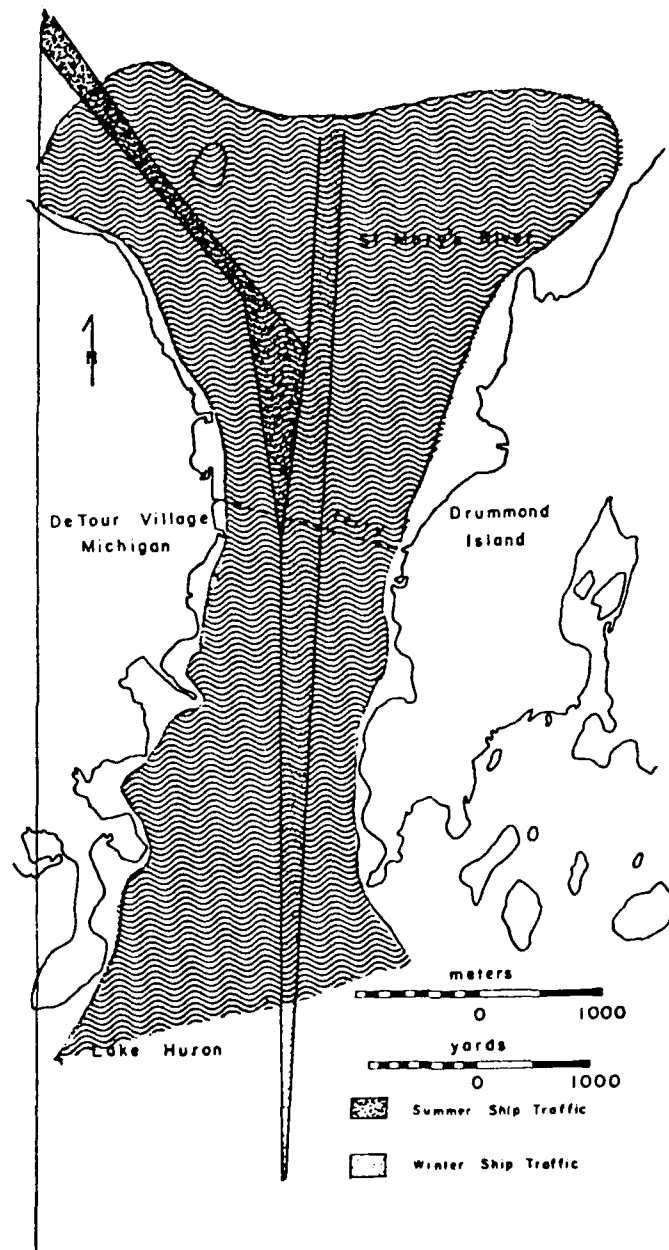


Figure 29. Map showing open water at DeTour Passage on 2 February 1980.

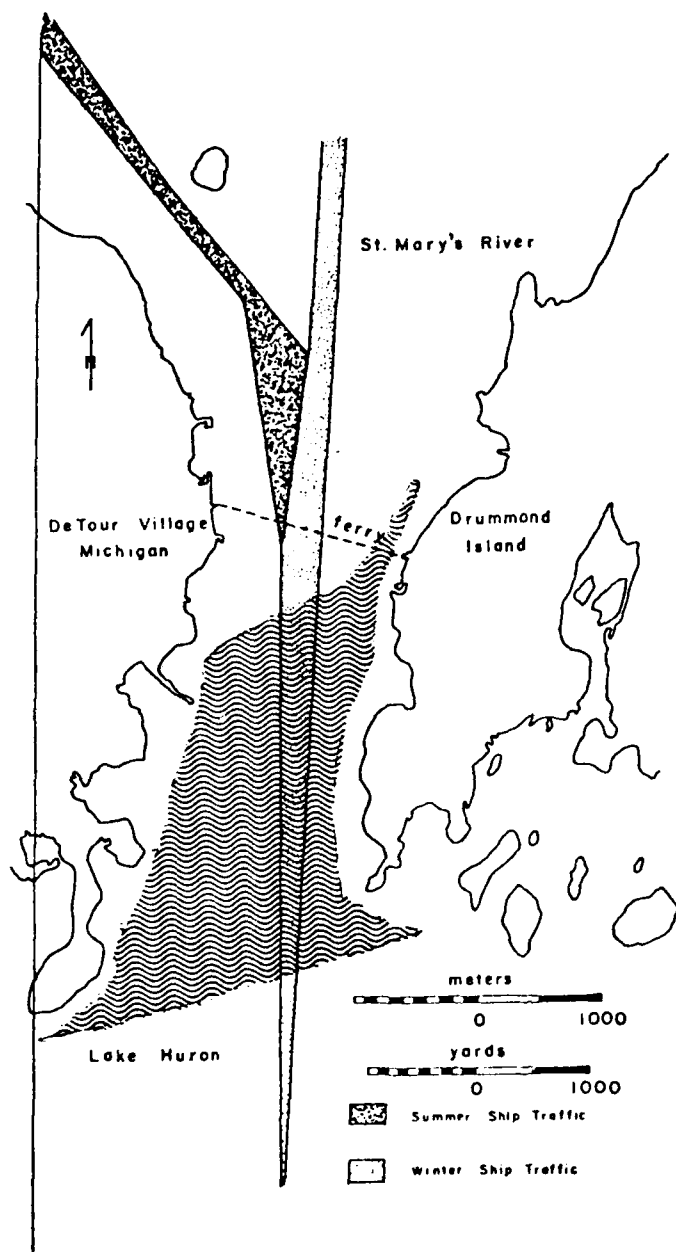
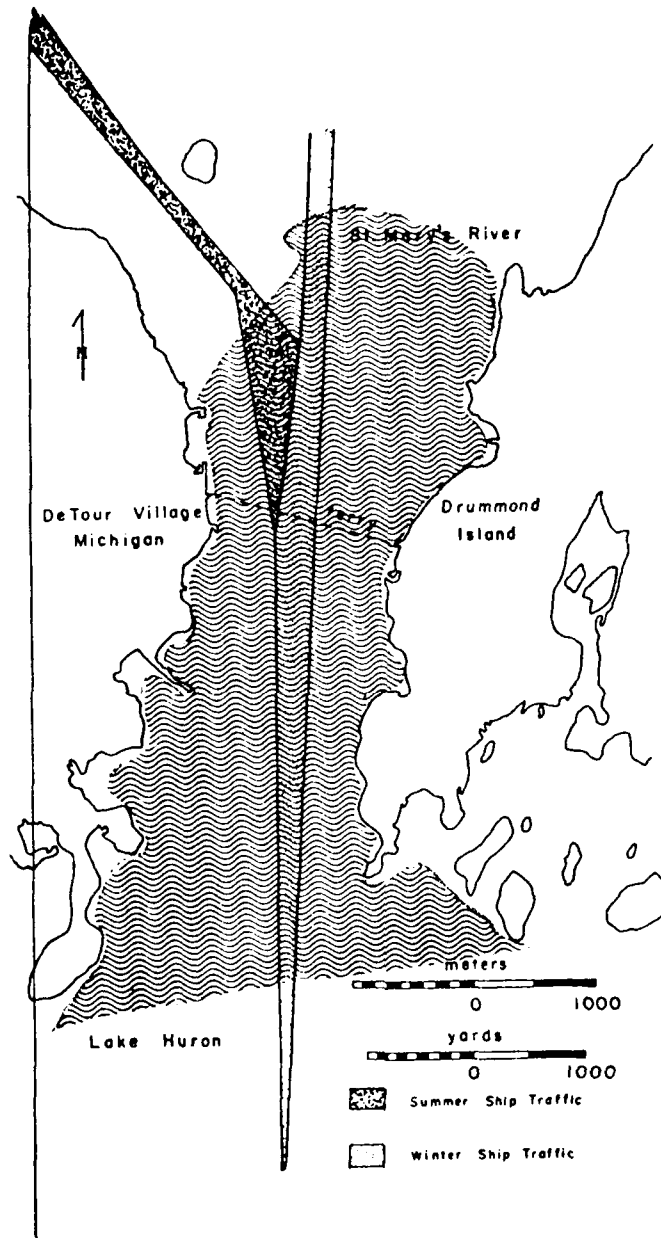


Figure 30. Map showing open water at DeTour Passage on 15 March 1980.



SHIP TRAFFIC

Navigation of the St. Mary's River continued all through the winter of 1979 (Figures 31 and 32). According to Mr. Steve Gillotte, U. S. Army Corps of Engineers Statistician (personal communication), the following numbers of cargo vessels logged through the locks at Sault Ste. Marie in 1979: January 153, February 23, March 28, and from 1-15 April, 80. There were also additional passages by U. S. Coast Guard and other U. S. and Canadian vessels. Although the 1979 number of passages was reported as being reduced from previous years of the demonstration program, the tonnage shipped during the extended season of 1979 was very close to that shipped during 1978, just over 6 million tons.

In 1980, shipping ceased on 15 January and was resumed on 24 March. Fifty-eight cargo vessels passed through the system from 1-15 January. The only vessel using the river between 15 January and 24 March was the Katmai Bay, a U. S. Coast Guard Ice Breaker which made brief trips down the river on 5, 6, and 22 February, and 11 March. On 22 March, the Katmai Bay opened a track to Lake Huron and was followed back up the river by the U. S. Coast Guard Cutter Mackinaw, which continued on into Lake Superior. The last week of March 1980 saw 29 cargo vessels through the St. Mary's River system, with another 183 logging through the locks between 1 and 15 April. This information is summarized in Table 2.



Figure 31. The ore carrier Stinson moving upriver through heavy ice. 16 February 1979



Figure 32. The ore carrier Arthur M. Anderson downbound at head of Little Rapids Cut. 21 April 1979

Table 2. Monthly Cargo Vessel Transits, 1979-1980¹.

Month	1979	1980	
January	153	Jan. 1-15 ²	58
		Jan 16-31	0
February	23	3 ⁴	
March	28	Mar. 1-23	3 ⁴
		Mar. 24-31 ³	29
April (1-15)	80 ⁵	259	

1. Numbers are for cargo vessels only, unless otherwise indicated. There were additional passages by Coast Guard and other U. S. and Canadian government craft.
2. Shipping ceased on January 15.
3. Shipping resumed on March 24.
4. Trips by U. S. Coast Guard Ice Breaker Katmai Bay on: 5, 6, 22 February and 11 and 22 March.
5. Estimated cargo vessel transits.

WATERFOWL

Species Present

Table 3 is a list of waterfowl species present on the study area between 10 January and 30 April 1979 and between 1 January and 30 April 1980. The bufflehead, black duck, wood duck, and harlequin duck were represented by fewer than 10 individuals for most of the winter of 1979. The black duck population numbered nearer 15-25 in 1980. In 1980, there were four fewer species present than in 1979; however, of these four species, only one individual of each the wood duck, blue-winged teal, and snow goose (Figure 33) was seen in 1979, along with only 3 pintails seen in April 1979, but not in 1980. During both study seasons, the waterfowl present in the greatest numbers through the coldest part of the winter were the common goldeneye, the common merganser, and the mallard. A small number of Canada geese were also present through the winter of 1979, but this was not the case in 1980. Figures 34 and 35 show the numbers of these species present over the course of the two winters.

Mallards and Black Ducks

The numbers and habits of the mallards and black ducks on the study area from January through mid-March were similar during both seasons of research with only slightly higher numbers in 1980 (Figures 34 and 35). The black duck population was small (8-25 birds) but constant. During the colder months (January-March) the vast majority of the mallard population was concentrated along the Canadian side of the river in Sault Ste. Marie, 2-3 miles (3.2-4.8 km) on either side of Bellevue Park. In daylight hours most of the mallards were found in or very near the park, with smaller groups scattered along the shore as far upriver as the Civic Centre and as far downriver as the Canadian sewage treatment plant. Judging from our observations, the bulk of their diet consisted of corn and other handouts received at Bellevue Park (Figure 36). At dusk the entire population would congregate near Bellevue Park and fly upriver to spend the night near the Civic Centre.

In both 1979 and 1980, the mallards' habits remained regular until late in March when the river began to open up and migration started. Migratory mallards and black ducks were first seen in the bays along the north shore of Lake Huron on 4 April 1979 and on 28 March 1980. On 21 March 1979, 15 mallards were noted near the south end of the Little Rapids Cut, and later mallards were seen at other locations along the Michigan shore where none had been seen previously, notably in the channels among Islands 1-4, on the west side of the Little Rapids Cut. Mallards were first seen in this area on 26 March 1980.

The mallard-black duck populations rose from about 370 birds at the end of March 1979 to about 450 by the end of April. In 1980, the rise

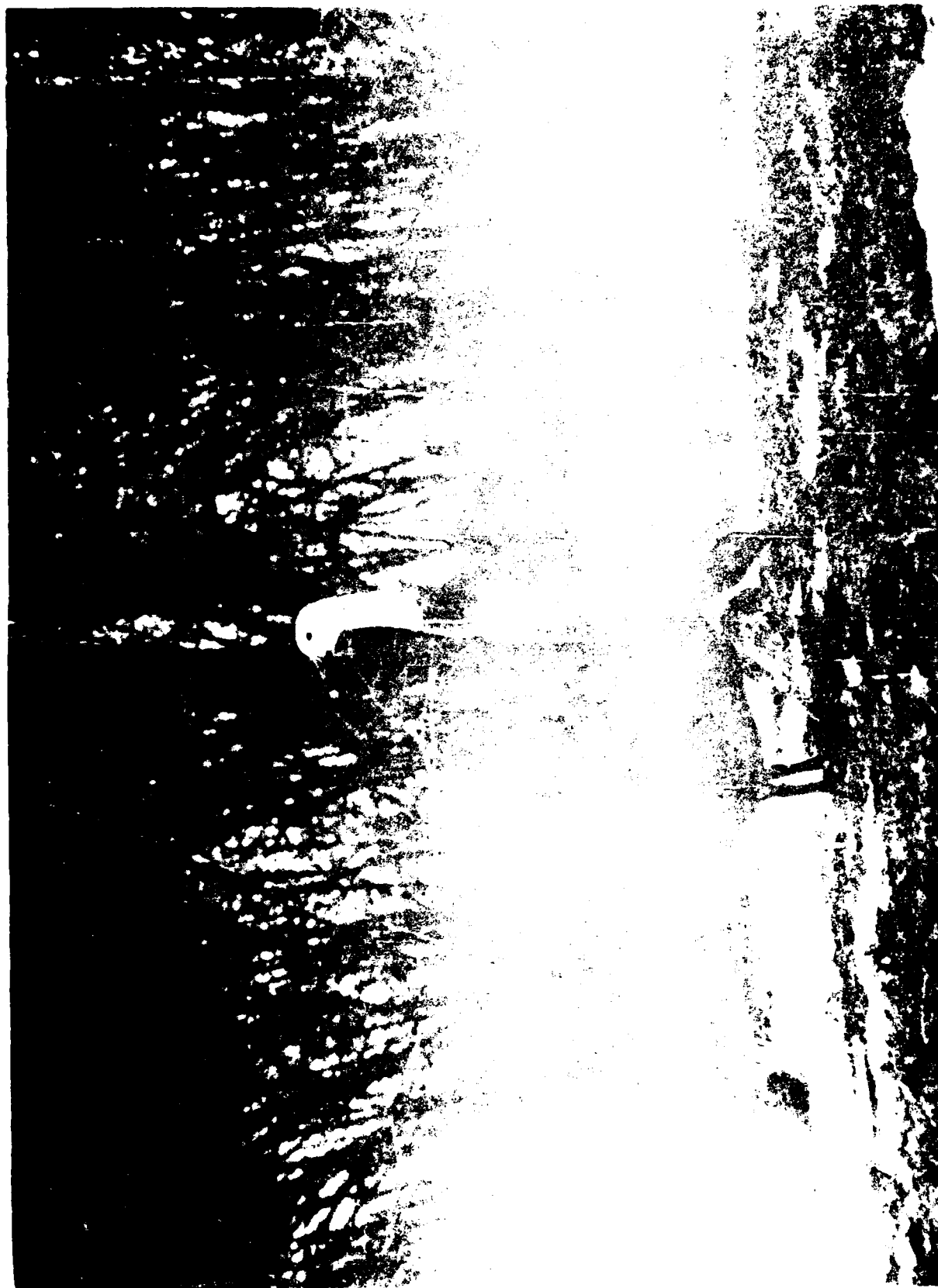


Figure 33. Snow goose (dark phase) and Canada goose at Sault,
Ontario Country Club. 3 April 1979.

Figure 34. Population estimates of mallards and black ducks, common goldeneyes, common mergansers, and Canada geese on the study area, January - April 1979.

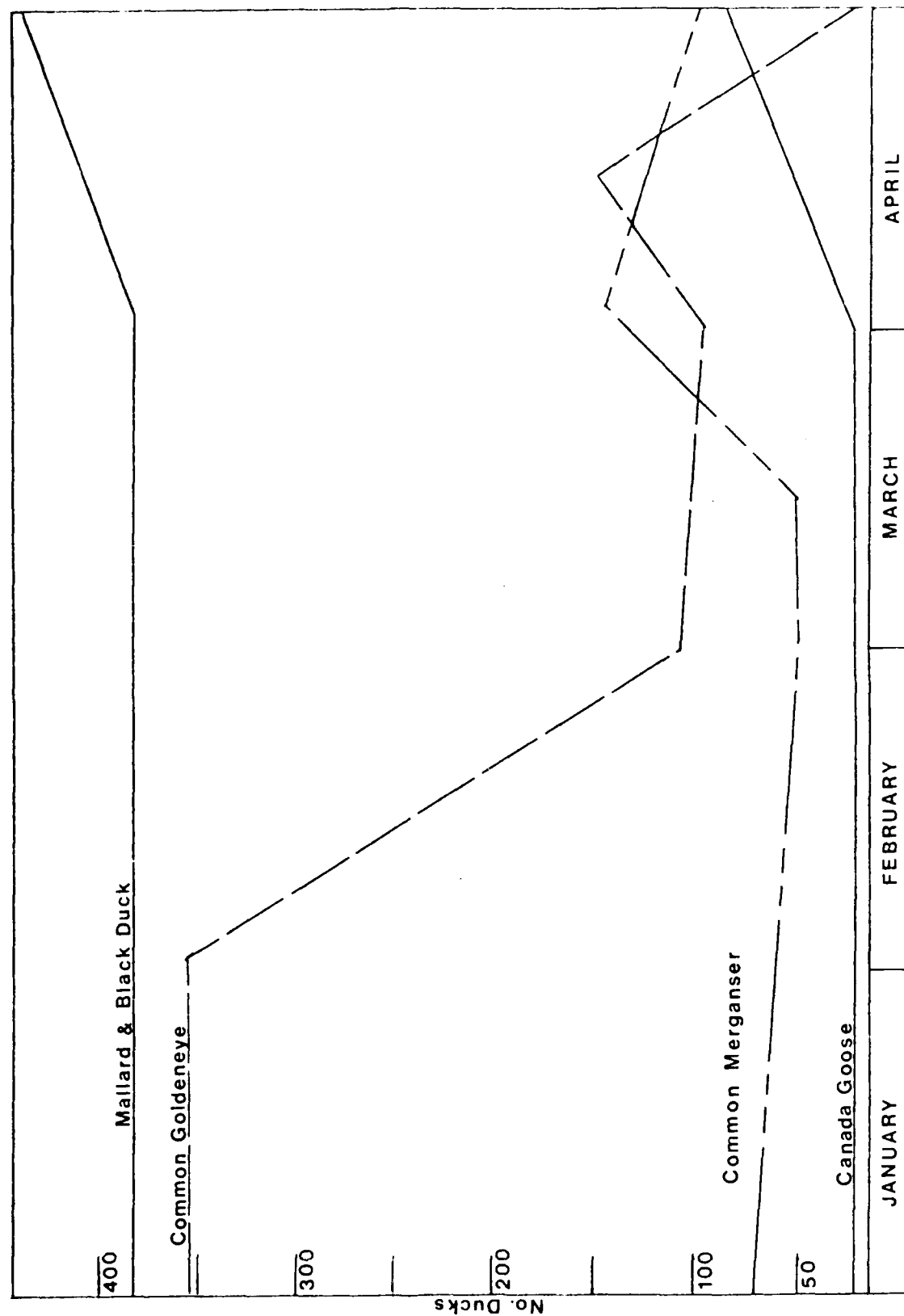


Figure 35. Population estimates of mallards and black ducks, common goldeneyes, and common mergansers on the study area, January - April 1980.

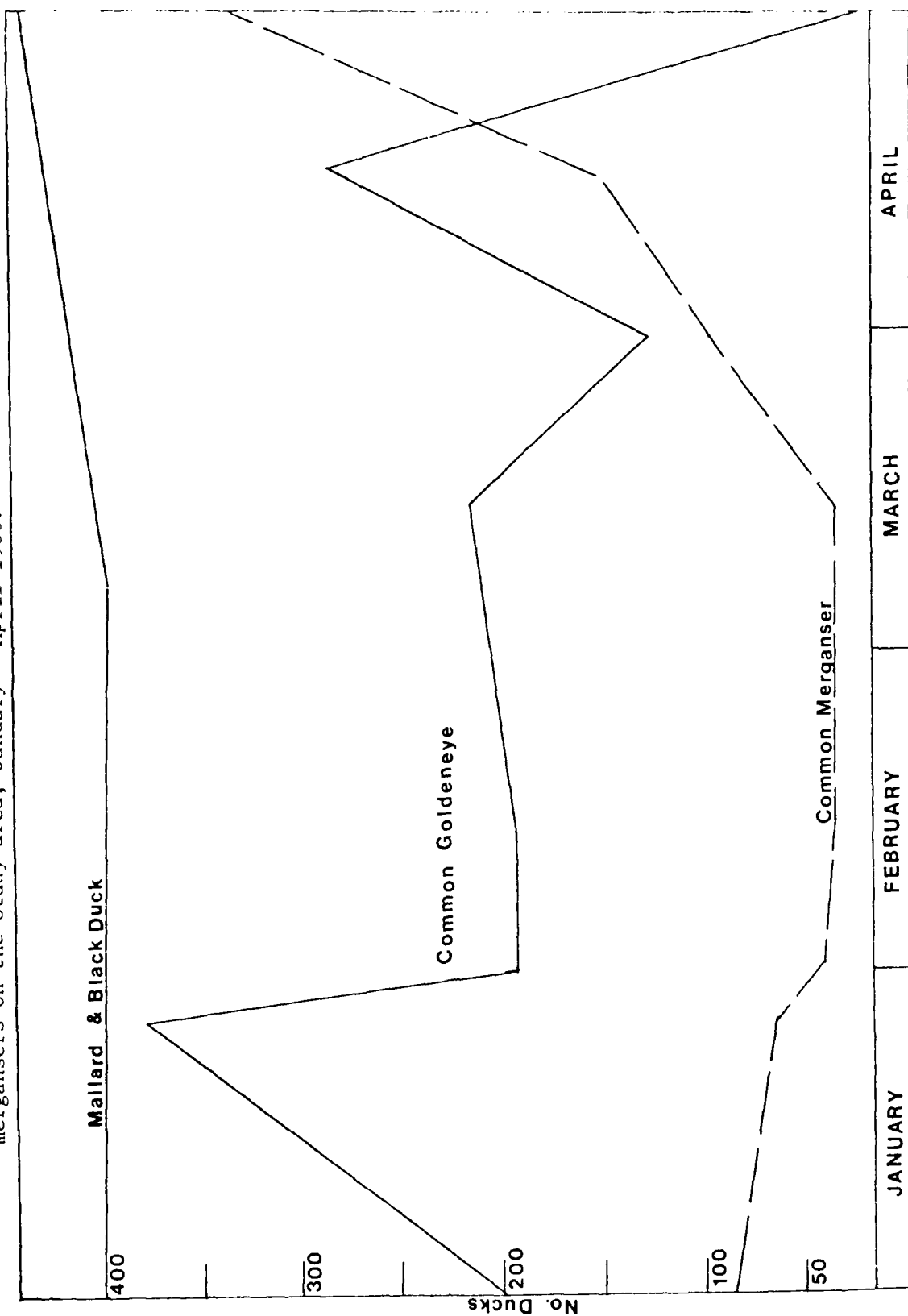




Figure 36. Mallards being fed at Bellevue Park, Sault Ste. Marie, Ontario. 17 February 1979.

began about 2 weeks earlier, and numbers went from around 400 in early March to 420-430 by late March and continued to rise through April, as Figures 34 and 35 have shown. Many of the birds still frequented Bellevue Park, but could also be found feeding and/or loafing at many locations along both sides of the river.

On 12 April 1979, leg bands were read on 2 drake mallards at Bellevue Park and the numbers sent to the Bird Banding Laboratory, U.S. Fish and Wildlife Service, Laurel, Maryland for verification. One of the ducks had been banded in Bellevue Park itself by Canadian personnel in August 1972, and the other near Ethel, Arkansas in January 1965. The former is probably a year-round resident of the park area, but it is not known whether the latter was a migrant or a bird that had translocated and become a winter resident. The mallards, black ducks and geese encountered in late March and in April are not all year-round residents.

Canada Geese

Canada geese were present all winter in 1979, but not in 1980. The geese present in 1979 numbered 14 and were most often seen together in one flock (Figure 37). They, like the mallards remained within 2-3 miles of Bellevue Park along the Canadian shore, and often fed with the ducks at the park. In April, the number of geese increased to 50-80 birds with the return of spring migrants.

On 10 January 1980, 13 geese were seen at the Moose Lodge (about 1 km downriver from the Sugar Island Ferry landing) on the Michigan side of the river, and 6 geese were seen flying east of Bellevue Park on 18 January. After that, none were seen until 30 March; the geese had presumably emigrated from the study area in late January. Their numbers increased to about 80 by the end of April 1980.

A band was read on one Canada goose in 1979. It had been banded near St. Marys, Ohio in April 1971. Attempts to read leg bands in 1980 were not successful. It is not known why the geese remained through the winter in 1979 but failed to do so in 1980.

Common Goldeneye

The common goldeneye (Figure 38) was the most numerous diving duck on the study area during both winters. Overall, there were more goldeneyes on the study area in 1980 than in 1979 (Table 2), with population fluctuations also being greater in 1980 (Figures 34 and 35). Peak numbers, attained in January of both years were similar, 353 in January 1979 and 368 in January 1980.

Common Merganser

While there were more mergansers (Figure 39) on the study area in 1980 than 1979, the numbers and population fluctuations were very much

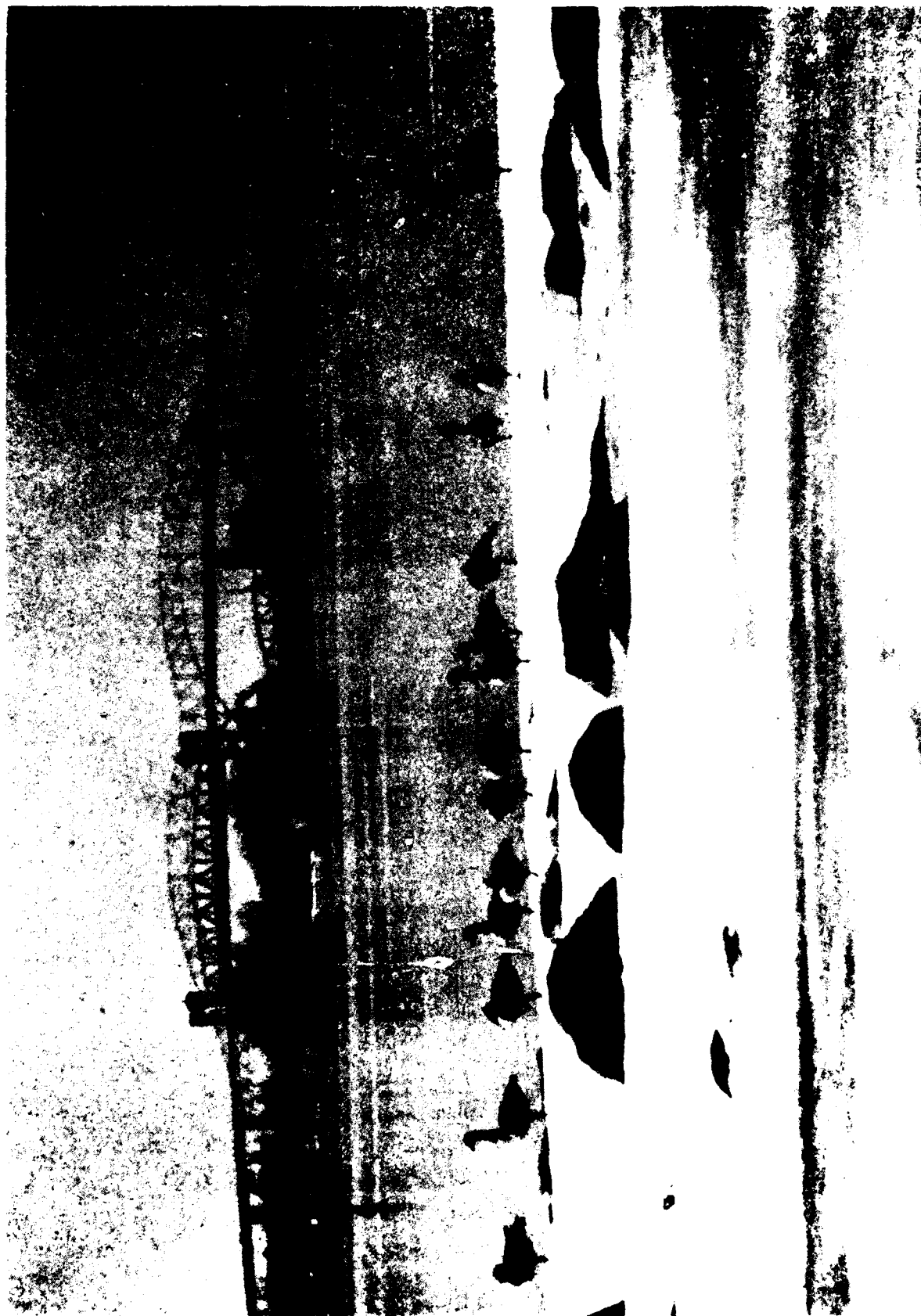


Figure 37. Thirteen of the flock of 14 Canada geese at Bellevue Park, Sault Ste. Marie, Ontario. 21 March 1979.

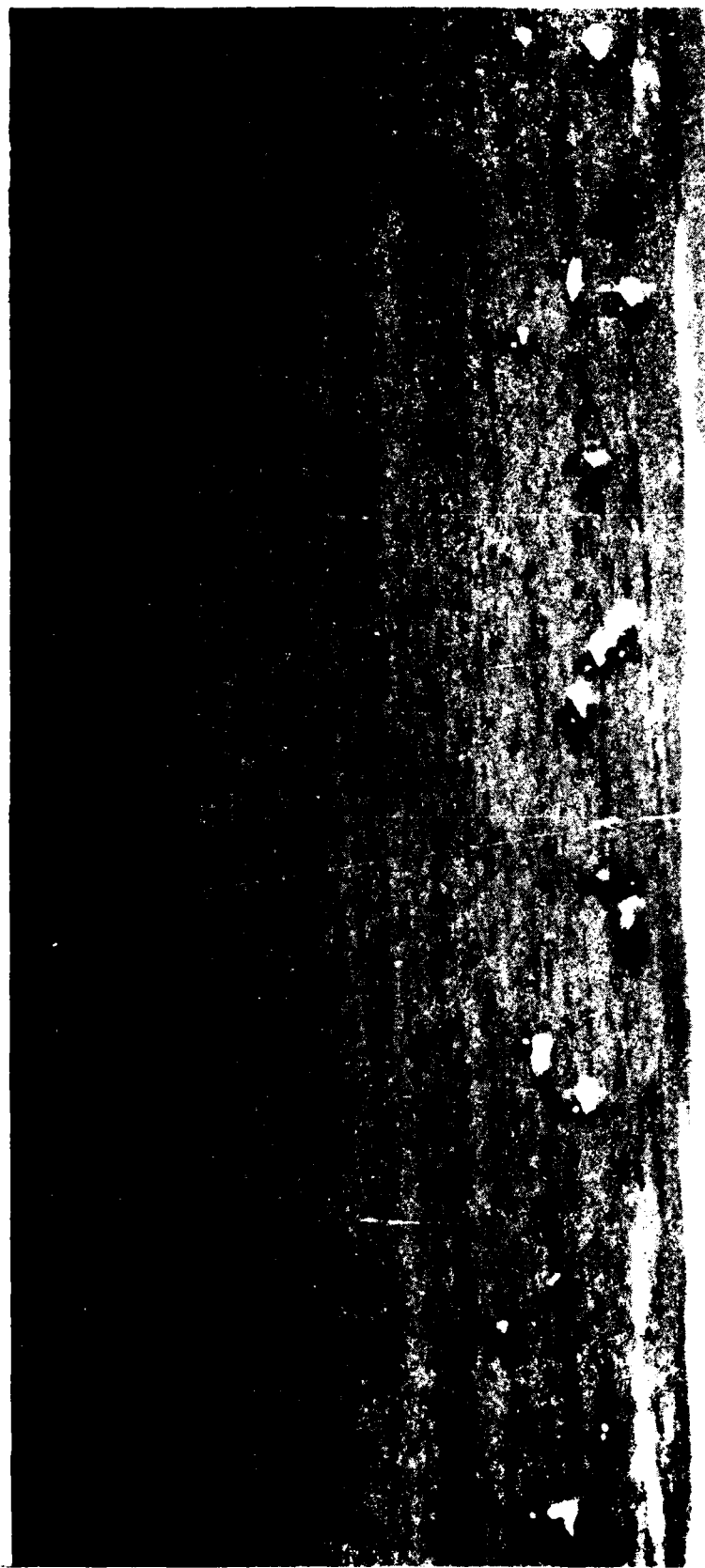


Figure 38. Flock of common goldeneyes near the Canadian shore of the North Channel. 14 February 1980.



Figure 39. A pair of common mergansers near the Sugar Island Ferry crossing. 3 April 1979.

alike except in April. There were 76-90 mergansers on the area at the beginning of the study in both years. The number declined steadily to fewer than 50 by mid-March and then began to rise as spring migrants returned. Figure 34 shows the number of mergansers declining in April 1979. Figure 35 indicates a substantial gain in numbers in April 1980. Up until mid-April, the patterns are much the same. The probable explanation for the late April discrepancy is that the last aerial survey of 1979 was flown on 16 April whereas the final 1980 survey was flown on 25 April when migration was more heavily in progress. There may have been more mergansers present in late April 1979 than were estimated if the birds were inhabiting areas not accessible for ground surveys and eluded detection. Also, it is suspected that migration may have been farther along in 1980 due to warmer temperatures. Finally, the estimated number of common mergansers in April 1980 may be high, due to the fact that common and red-breasted mergansers are almost impossible to tell apart from an airplane.

Summary of Waterfowl Populations

During January of both study seasons, about 1000 waterfowl were present, represented by 8 species in 1979 and by 7 species in 1980. In 1979, numbers declined through February and into March, primarily due to emigration of goldeneyes. There was a sharp decline in the number of goldeneyes at the end of January 1980, after which numbers leveled off until mid-March. Mid-March of both years saw increases that continued through April. In late April 1979, waterfowl numbers were estimated at between 1000 and 2000 birds (with wide daily fluctuations) represented by 16 species. On 25 April 1980, nearly 3000 waterfowl of 11 different species were counted.

Declines in numbers that were observed during the winter were to be presumed due to emigration of birds from the study area rather than to mortality. Through both study seasons, there were only three dead waterfowl seen by us or reported to us. (All three cases involved bald eagles. Details will appear later in the report.) This is in direct contrast to the reported high waterfowl mortality of wintering birds on the Detroit River (U.S. Army Corps of Engineers 1977; Reed 1971).

Areas Used by Diving Ducks

DeTour-Drummond Island Area. Waterfowl were observed in this area on several occasions, but never in great numbers. The largest number of ducks counted there was 10 birds on 11 January 1979. Ice conditions were highly unstable and unpredictable in 1979, being affected by temperature, wind direction and velocity, and to an extent by ship traffic. Ice conditions were less erratic in 1980 with the southern half to two-thirds of the passage remaining open except in late February and early March, when a cold spell froze the passage over briefly. Even though open most of the winter of 1980, the area was still used only sparsely by waterfowl. The channel in the DeTour-Drummond Island area is not considered critical waterfowl habitat.

Neebish Island Rock Cut. The Rock Cut remained open all winter of both years due to swiftness of current. Even so, this area is also only lightly used, mainly by common mergansers and a few common goldeneyes. The largest number of ducks encountered at the Rock Cut was 13 birds on 15 February 1979. This area is not considered critical waterfowl habitat.

Sault Ste. Marie Area. Overall, the open water around the city of Sault Ste. Marie was much more constricted in 1979 than in 1980, due to the severity of the winter. Even so, the areas used by the diving ducks were much the same. In both years, there was an open tract of water from the Sault Locks to the Little Rapids Cut, regardless of ship traffic. Within this area, the ship lane was not used in 1979 by divers, but was in 1980. Reasons and implications will be discussed shortly. The areas most heavily used, however, were out of the ship lane, although some of them were adjacent to the channel.

During both winters, the Edison Soo Hydro outfall (Figure 40) was the favorite night roosting spot for both goldeneyes and mergansers from early January until 8 February of both years. After that date, a small number of mergansers continued to use the outfall as a night roost. However, most of the mergansers and all of the goldeneyes began to use other areas for night roosting, notably the Algoma Steel Coolant outfall area and the Sault, Ontario sewage treatment plant outfall. It might be noted that the goldeneyes stopped using the Edison Soo outfall well before the surrounding ice cover dissipated (18 March 1979 and 24 February 1980). The goldeneyes stopped using the outfall on 8 February of both 1979 and 1980. The exact reason is unknown. It may be that the ducks using the outfall as a night roost were migrants, merely passing through; however, no drastic decline in numbers of goldeneyes on the study area was noted after 8 February of either year. Since February was colder in 1979 than in 1980, it seems doubtful that the weather was the cause for the change in behavior. The fact that the change occurred on exactly the same date both years suggests that possibly some internal mechanism may have been at work, such as a change in hormone levels which might reduce flocking behavior.

The favored daytime feeding areas of both goldeneyes and mergansers were much the same from January through mid-March of both years. One of these areas was the St. Mary's Falls (or Rapids), just below the International Bridge, which remained open through both winters. The ducks would drift down the rapids, diving and feeding as they went and then fly back to the head of the rapids for rest or another feeding trip. On 16 February 1979, 65 goldeneyes were counted feeding and resting at the rapids; on 31 January 1980, approximately 100 goldeneyes were seen at the rapids (Figure 41).

Another area used consistently though not heavily during the day was the Edison Soo Hydro outfall. This spot was used more by mergansers than by goldeneyes. This is possibly due to the fact that fish killed in the turbines would provide a source of food for the mergansers, which are primarily fish feeders (Bellrose 1976), more so than for goldeneyes which rely more on benthic organisms (Pirnie 1935; Bellrose 1976). The major usage of the hydro outfall however, was as a night roost, as described earlier.



Figure 40. The Edison Soo Hydro outfall. 16 February 1980.



Figure 41. The St. Mary's Falls. A favorite goldeneye feeding spot. 13 February 1979.

The Algoma Steel coolant outfall was used as a feeding area in 1979, but not nearly as heavily in 1980. On 8 March 1979 at 6:00 P.M., 105 goldeneyes and 25 mergansers were counted there. The largest number of birds counted at the outfall area in 1980 was 40 goldeneyes, seen on 31 January.

Both goldeneyes and mergansers could be found in heavy concentrations in the open water areas of the North Channel along the Canadian shore from the Civic Centre to Little Lake George (Figure 42). (Areas beyond Little Lake George were used only sparsely when open.) On 19 February 1979, 105 goldeneyes and 20 mergansers were counted along the North Channel; on 23 February 1980, there were 133 goldeneyes in this area. The ducks were generally strung out all along the open water areas along the North Channel, with one area of concentration, the Sault, Ontario sewage treatment plant. Several observers have documented evidence of goldeneyes feeding at sewage outfalls in winter (Campbell 1977; Campbell and Milne 1977; Pounder 1975). On 12 April 1979, we counted 105 goldeneyes feeding outside the sewage treatment plant, and about 80 goldeneyes there on 30 March and 14 April 1980.

By late March, the ducks were frequenting newly open areas in favor of those areas used heavily during the preceding months, with the exception of the sewage outfall, presumably for fresh food supplies. These new feeding areas included previously ice covered stretches of the North Channel, the channels between Islands 1-4 and between those islands and the Michigan mainland (Figure 43), and the area north of the Sugar Island Causeway (north and east of the island side ice boom). The mergansers especially were to be found around Islands 1-4 and in the North Channel east of the sewage treatment plant, whereas the goldeneyes preferred the plant itself and the area north of the Sugar Island Causeway.

With the return of spring migrants in late March and in April of both winters, the habits of the ducks which had previously been fairly predictable, became erratic. As migration progressed during both springs, scaup (Figure 44) rapidly became the most numerous duck on the study area, numbering as many as 2000 on 25 April 1980.

The common goldeneye, common merganser, mallard, black duck, and the Canada goose are common winter residents at other northern fresh water regions, such as at Montreal, Quebec (Reed and Bourget 1977) and at Minneapolis, Minnesota (Cooper and Johnson 1977). However, it is suspected that the mallards, black ducks, and geese remain largely because of available artificial feed (Sugden, et al 1974). Also, Bellrose (1976) stated that some species of waterfowl, particularly the mallard and Canada goose are remaining farther north than in the past because of "man's influence on the environment"; such influences include warm water effluents from power plants and manufacturing which keeps water open that would otherwise be ice covered (Nelson 1967).



Figure 42. The North Channel east of Sault Ste. Marie, looking west. 10 March 1980.



Figure 43. The Little Rapids Cut looking north. Islands 1-4 at center. 16 April 1979.



Figure 44. Greater scaup in the water outside Bellevue Park,
Sault Ste. Marie, Ontario. 13 April 1980.

Impacts of Winter Shipping on Waterfowl

Direct Effects. It has become apparent after two winters of study that ship traffic has an effect of waterfowl behavior. As was mentioned earlier, during the coldest months of 1979, ducks largely avoided the ship channel, even though the channel was open through the city all winter. During April 1979 however, as areas south of the Little Rapids Cut and west of the Sault Locks opened up, ducks began using the ship channel in these areas, largely for feeding. The southern area (near Three Mile Road at the south end of the Little Rapids Cut) was used primarily by common mergansers along with a few common goldeneyes and buffleheads. The western area (known as "the Shallows" near Izaak Walton Bay) was used mostly by scaup, and a few goldeneyes and buffleheads.

On a number of occasions, we recorded flying waterfowl associated with ship passage (Figures 45-48). It is known that common goldeneyes will react (by flying) to power boats which approach within 350-400 meters of them (Hume 1976). The number of ducks flying when a ship was near (within 400 meters) was greater than either before its arrival or after its departure, strongly suggesting that the ship causes the ducks to flush. Also, the number of waterfowl in an area was lower after passage than before. The birds were probably moving into areas in which there was less disturbance from ships. The only exception in the data presented was the 13 April 1979 passage of the John Dykstra (Figure 46). The number of ducks flying did not diminish after the ship had passed. This may be explained by the fact that the afternoon was growing late, and the ducks may have been moving naturally toward night roost areas.

During the January-March period of 1979, the occurrence of birds being flushed by ships seemed relatively rare. The phenomenon increased dramatically in April, with the presence of more open water and more ship traffic. There are two possible explanations for the change. The ducks being flushed may have been migrants new to the area, as the scaup were, rather than birds that had wintered there, and these new arrivals had not learned where to land without being disturbed by ships. The second possibility is that if the birds being flushed had wintered in the area, they may not have associated the recently ice free areas with ship passage, as they had with places that had been open all winter.

The effects of flushing by ships on the ducks during this time of year is not known. It must be somewhat metabolically taxing for the birds to be flying more than normal, but whether or not this is harmful is uncertain. It would depend on air and water temperatures, available food resources, and physical condition of the birds.

In late March and April of 1980, after resumption of shipping, several attempts were made to observe the flushing of ducks by ships; however, no more than 2-3 birds at a time were ever observed being disturbed by a passing ship, and interactions between ships and waterfowl were virtually non-existent. A comparison was made between the number of ducks observed using the ship channel for feeding or resting in 1979 and 1980 (Table 4). The "ship

Figure 45. The effect of passage of the ore carrier Grosbrenner on ducks flying near Izaak Walton Bay. 13 April 1979.

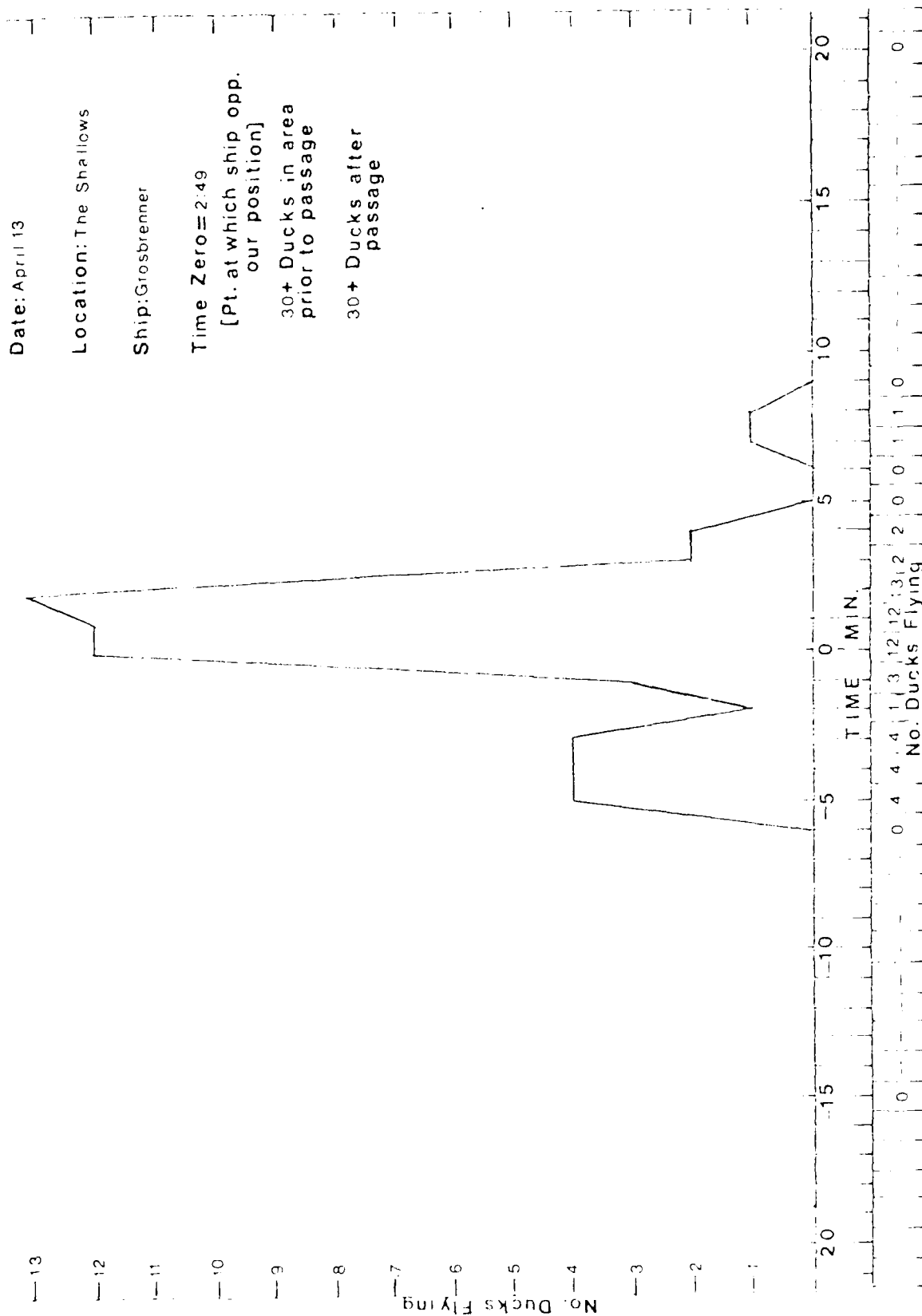


Figure 46. The effect of passage of the ore carrier Dyksta on ducks flying near Izaak Walton Bay. 13 April 1979.

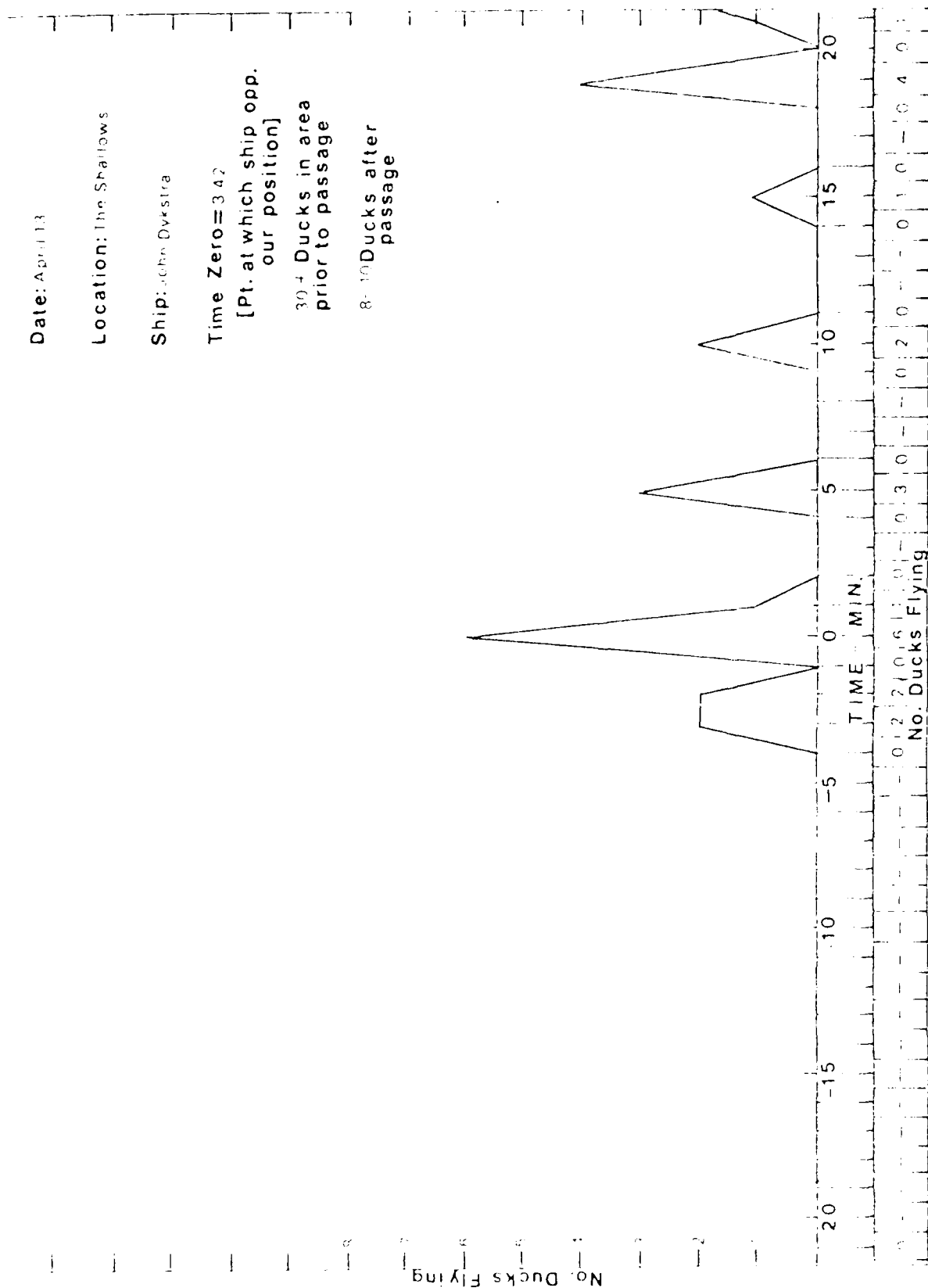


Figure 47. The effect of passage of the ore carrier Block on ducks flying near the south end of the Little Rapids Cut. 17 April 1979.

Date: April 17
 Location: 3 Mile Rd
 Ship: Philip D Block
 Time Zero = 10:45
 [Pt. at which ship opp.
 our position]
 10 Ducks in area
 prior to passage
 3-4 Ducks after
 passage

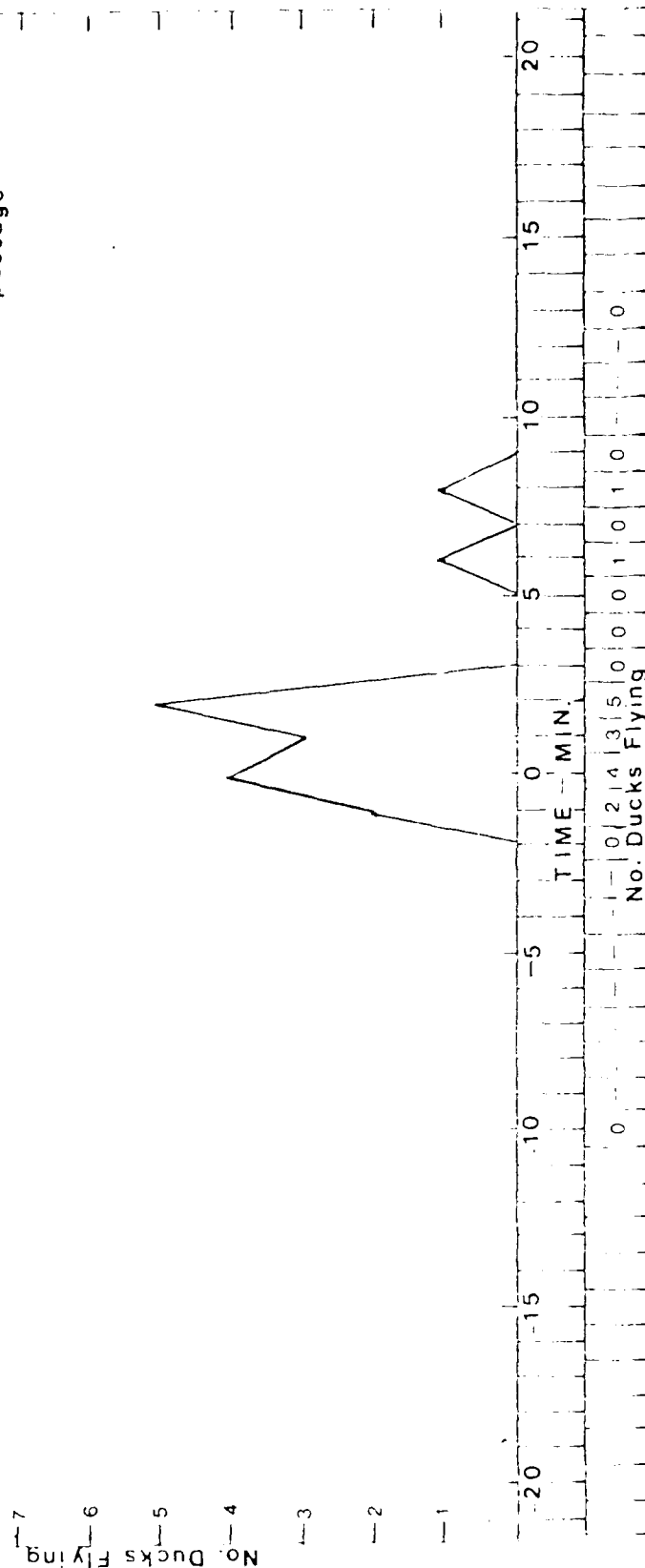


Figure 48. The effect of passage of the freighter New Haven on ducks flying near the south end of the Little Rapids Cut. 27 April 1979.

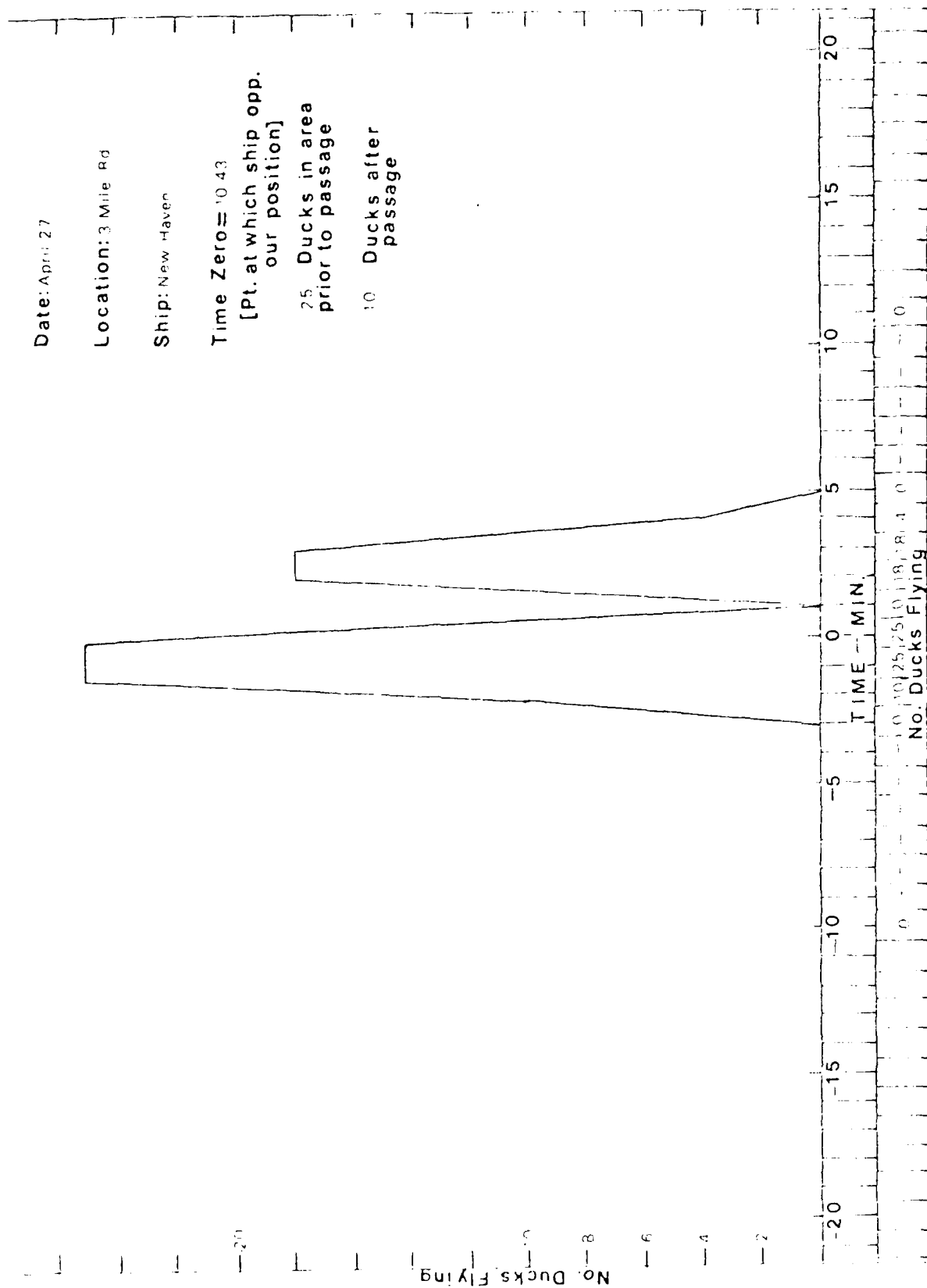


Table 4. The Number of Ducks per Hour of Effort Observed Using the Ship Channel for Feeding or Resting. (Total Number of Ducks Observed is in Parentheses.)

Month	1979		1980
January	0.46 (16)	1-15 January ¹	2.00 (40)
		16-31 January	4.04 (97)
February	1.10 (45)		3.91 (125)
March	1.67 (45)	1-23 March	12.07 (169)
		24-31 March ²	2.77 (36)
April	4.41 (141)		0.77 (10)

1. Shipping ceased on 15 January 1980.

2. Shipping resumed on 24 March 1980.

channel" is the area designated on earlier maps as a stippled pattern and keyed as "winter ship traffic" or merely "ship traffic". The numbers of waterfowl using the channel in 1979 were consistently low until April. The place where these birds were most often observed was at the head of the Little Rapids Cut near the Sugar Island Ferry crossing (Figure 49). The largest groups of birds observed were: 4 in January, 9 in February and 15 in March. In April 1979, the majority of the 141 waterfowl observed in the ship channel were found in newly open areas mentioned earlier and not near the city.

In January-March 1980, the numbers are much higher. There was a sharp increase in ducks using the ship channel after shipping ceased and a sharp decrease immediately after shipping resumed, dropping to an extremely low level in April. Table 2 shows the number of vessels going through the St. Mary's River. The relationship between the number of ships passing through the river and the number of ducks (per hour of observation) using the ship channel is shown in Figure 50. The logarithms of the number of ships and the number of ducks per hour of observation were correlated. There is a statistically significant negative correlation ($r = -0.719$, $p < 0.05$) between the two. In 1980, the ducks were virtually undisturbed from mid-January until the last week of March. Shipping began slowly in the first 2-3 days of the season but picked up rapidly and continued at a brisk pace all through April, with as many as 41 vessels logging through the locks on 28 April. The disturbance apparently became so constant almost immediately upon resumption of shipping, that the ducks deserted the shipping lane altogether, and stayed away from it completely. The conclusion that shipping has a definite effect on behavior of waterfowl is further supported by the fact that in the absence of shipping in 1980, many ducks preferred to use the ship channel, even though there was more open water available elsewhere than there was in 1979, when they avoided the ship channel.

Ship traffic was so heavy in April 1980 (750 vessels during the month) that even migrant waterfowl seldom used the ship channel. Our final aerial census, flown on 25 April 1980 showed that of more than 3000 waterfowl seen, only 329 (or about 10%) were located in portions of the river navigated by cargo vessels. Of those, only 34 (1-2% of the total) were found in places less than $\frac{1}{2}$ mile (0.8 km) in width, and only 16 (0.5% of the total) were seen directly in the ship channel itself.

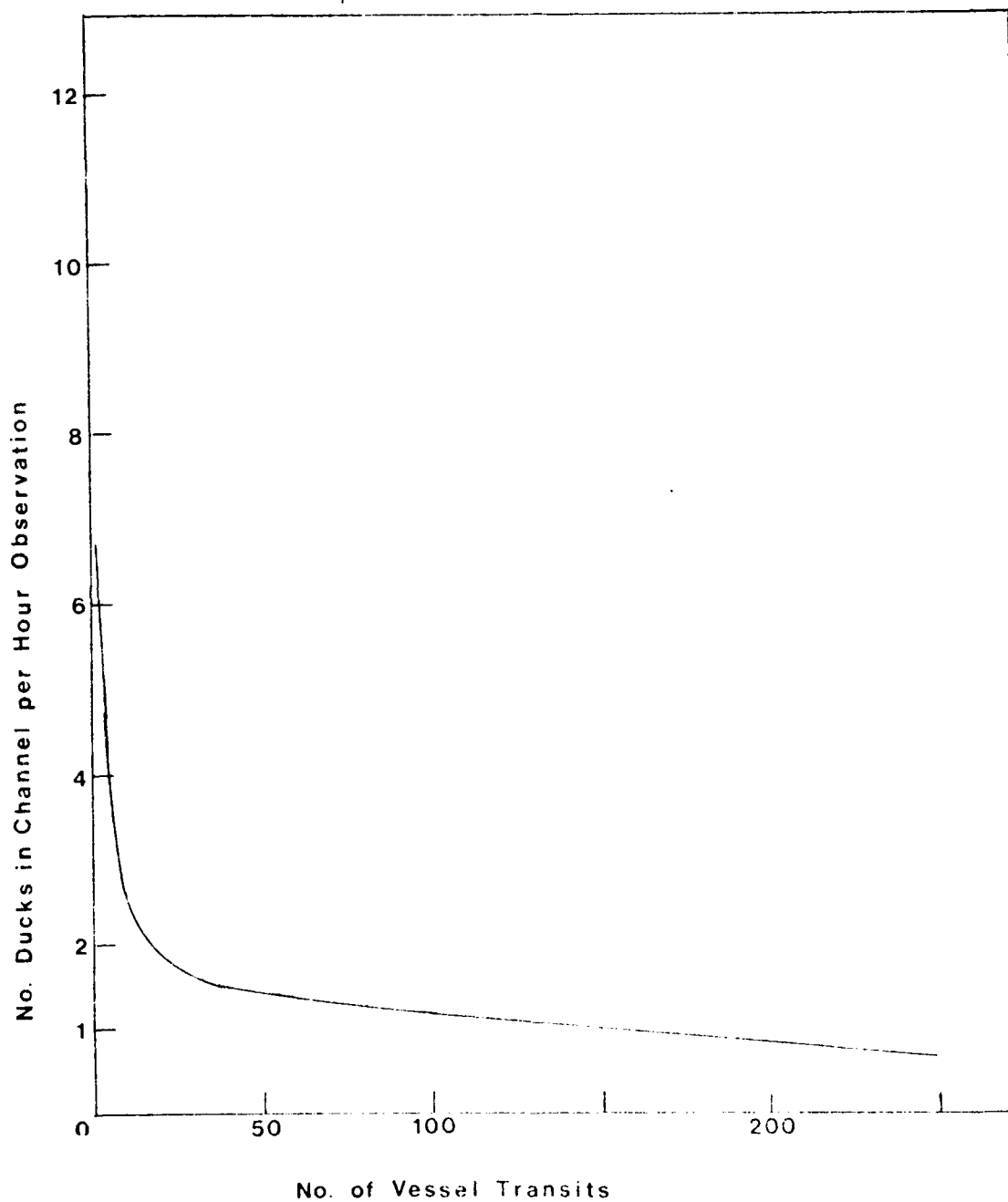
Potential Effects. The spillage of oil or some other toxic substance in the St. Mary's River represents a potentially very serious impact of shipping on waterfowl. The extent of the damage to waterfowl populations of such an occurrence would depend on the amount of material spilled, its location, and the speed with which it was cleaned up, although once under the ice, this would become a formidable task. The greatest negative impact would be seen if a large spill occurred in the upper reaches of the river, where currents would carry the material swiftly downstream.

Erosion of shoreline vegetation caused by shipping could reduce waterfowl nesting habitat and brood cover, thus reducing reproductive success. Finally, increased turbidity of river water due to prop wash could reduce light penetration, thereby reducing productivity and waterfowl food availability.



Figure 49. The north end of the Little Rapids Cut at the Sugar Island Ferry crossing.
Sugar Island in the foreground. 13 February 1979.

Figure 50. The number of ships passing through the St. Mary's River versus the number of ducks per hour of observation in the ship channel.



RAPTORS

Table 5 lists the species of raptors observed on the study area during the winters of 1979 and 1980. Of the species listed, only two were seen regularly, the bald eagle (*Haliaeetus leucocephalus alascanus*) (Figure 51) and the snowy owl (*Nyctea scandiaca*). The gyrfalcon was the only other species closely associated with the river, although there was one incident observed at the Rock Cut (at Neebish Island) on 15 February 1979 in which an adult goshawk (*Accipiter gentilis*) briefly and unsuccessfully pursued a flying drake goldeneye.

Snowy Owls

Snowy owls were observed commonly during the two winters of study, but most often, they were sighted perched in trees several miles from the river. On six occasions, however, snowy owls were observed within 100 m of the St. Mary's River. In all cases the sightings were along the river in the city. The sightings are summarized in Table 6 and their locations shown in Figure 52.

While snowy owls rely primarily on small mammals for food, they have been known to kill a number of bird species, including "water birds in winters when mammal food is not so easy to obtain." (Bent 1961). Included among such food items are grebes, small gulls, ducks, young geese, various grouse, and small passerines. They have also been known to catch fish and other small aquatic animals in places where water remains open (Bent 1961). This would explain the presence of the owls so near the river, but they were never seen pursuing, capturing, or eating any food item near the river. The effects of ship traffic on their behavior is unknown. The four snowy owl sightings made on the river in 1980 compared with two in 1979 do not represent a statistically significant increase associated with the lack of winter shipping.

Eagles

Numbers, Dates Seen, and Areas Used. A pair of adult bald eagles was observed regularly in the Sault Ste. Marie-northern Sugar Island area each of the two winters. Because the eagles were not individually marked, it was not known whether the same pair was present in both winters, or whether a different pair was present in 1980 than in 1979. In 1980, eagles were also seen near the south end of Sugar Island. While this was possibly a second pair, it was not certain since no more than two eagles were ever seen at one time. Eagles do not appear to be territorial during the winter, as many eagles will gather in one spot, with many birds even perched in the same tree, in places where food is available (McClelland 1973, Nye 1979). The open water area near the city of Sault Ste. Marie would seem to afford the eagles their greatest opportunity for securing fish or waterfowl, which along with carrion, are their major food sources in places where they winter in northern latitudes

Table 5. Raptors Seen on the Study Area in the Winters of 1978-79 and 1979-80.

SPECIES		1978-79	1979-80
Northern Bald Eagle	(<i>Haliaeetus leucocephalus alascanus</i>)	X	X
Goshawk	(<i>Accipiter gentilis</i>)	X	
Rough-legged Hawk	(<i>Buteo lagopus</i>)	X	X
Red-tailed Hawk	(<i>Buteo jamaicensis</i>)	X	X
Gyr Falcon	(<i>Falco rusticolus</i>)	X	
Snowy Owl	(<i>Nyctea scandiaca</i>)	X	X
Great Gray Owl	(<i>Strix nebulosa</i>)	X	

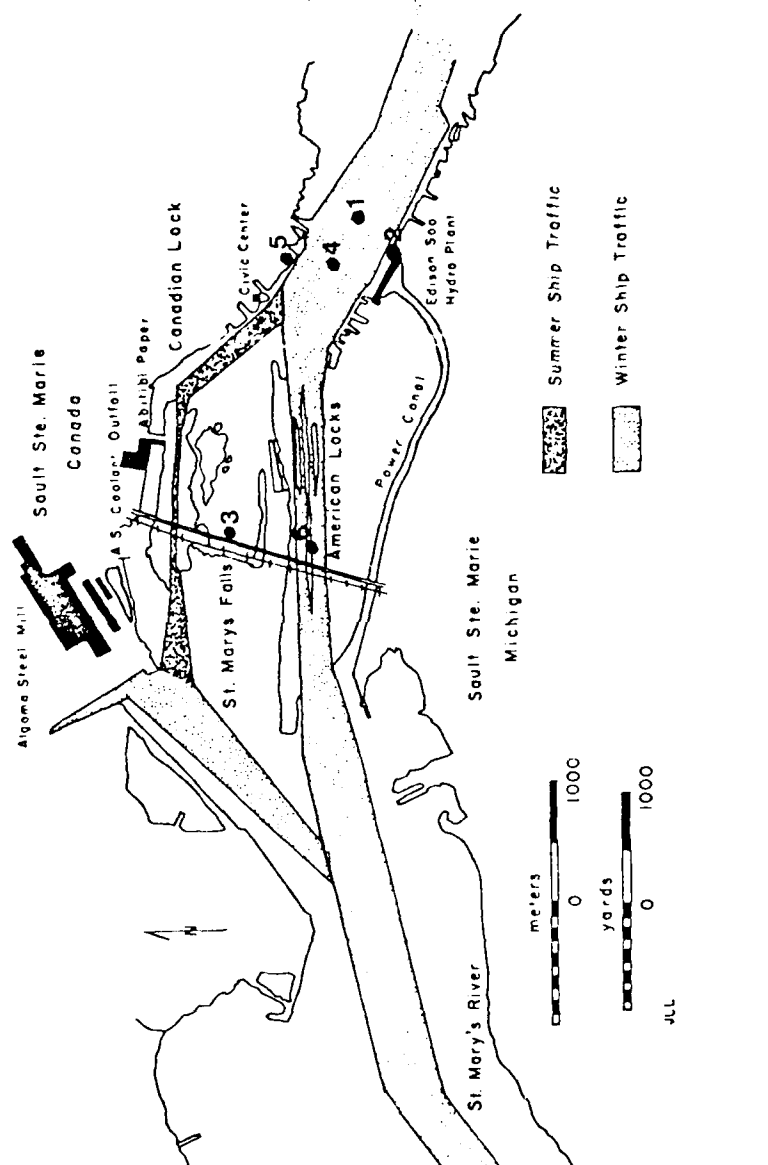


Figure 51. Adult bald eagle flying south at the head of the Little Rapids Cut. 16 March 1980.

Table 6. Summary of Observations of Snowy Owls Within 100 m. of the St. Mary's River in the Winters of 1978-79 and 1979-80. Observation Numbers Correspond with Numbers Shown in Figure 52.

Observation Number	Date	Location	Comments
1	18 Jan. 1979	River, mid-town	Owl flying downriver, altitude about 30 m.
2	23 Jan. 1979	Edison Soo Power Plant	Owl perched on southeast end of plant building.
3	15 Jan. 1980	International Bridge	Owl flying downriver over the bridge.
4	24 Jan. 1980	River, mid-town	Owl perched on the ice, center of the river for 40 min. Watched evening waterfowl flights, flew downriver.
5	9 Feb. 1980	River, mid-town	Owl flying upriver, perched on a riverfront building, Sault, Ontario.
6	24 Feb. 1980	Sault Locks	Owl perched on a light pole on Locks property.

Figure 52. Locations of snowy owl sightings within 100 meters of the St. Mary's River.



such as Michigan (Lerg 1979) and Maine (Owen and Todd 1979); one might expect that if more than two eagles were present, they would likely be seen in this area. Eagles return to the same nest site year after year (Broley 1952), and banding studies by McClelland (1980, personal communication) have shown that at least some migratory eagles return to the same wintering grounds in successive years. A pair of bald eagles nest on Sugar Island. In Maine eagles are known to winter close to their nesting grounds (Owen and Todd 1979), therefore it is possible (and we suspect) that the eagles nesting on the island are the same pair that winter on the study area.

The eagles could be seen regularly from late January to mid-March of 1979 and 1980 at one of two favored daytime perches (shown as "1" and "2" in Figure 53) near the northwest end of Sugar Island. On Perch 1, a small island (Figures 54 and 55), the eagles used a dead branch of an aspen tree in 1979. This branch, however, broke off some time in January 1980, and the eagles began using the island's two tall spruce trees as perches instead. In 1980, Perches 3 and 4 were also used heavily for a short time in early March. The eagles were not seen anywhere in the vicinity of north Sugar Island after 20 March 1979 and only once after 17 March 1980. (That exception was a sighting of one eagle on the ice near Hog Island on 30 March.) The pair may have deserted the area and migrated northward, or they may have moved to the south end of Sugar Island to begin nesting on or near their wintering grounds, such as eagles in Maine (Owen and Todd 1979) and Montana (McClelland, personal communication) have been known to do. One adult bald eagle was seen on, or near a nest on both of the final aerial surveys of 1979 (2 and 16 April). Unfortunately, we were unable to fly in early April 1980, but two adult eagles were seen by us at a nest on 25 April 1980, and again in May 1980 by Tom Weise (Michigan Department of Natural Resources).

Tables 7 and 8 are compilations of the numbers of hours spent in the field searching for eagles (and waterfowl) in the eagles' home range in 1979 and 1980, and the frequencies of sightings of eagles, by months and hours of the day. "Hours of effort" is defined as each hour or portion thereof spent in the field (making ground or aerial observations) within the area delineated as eagle home range in Figure 56.

Eagles were seen only rarely before 0900 or after 1600 E.S.T. They were seen with greatest frequency during January and February of both 1979 and 1980. Except when seen perched in one of the usual places, flying, or sitting on the ice, their whereabouts remained largely unknown. Other researchers have had similar problems (Nye 1979). The daily movements of the eagles on our study area seemed quite erratic, unlike those of eagles wintering in southeast New York as described by Nye (1978). Also, we had no idea where the birds were roosting at night. Along the Mississippi River between Minnesota and Wisconsin, eagles chose secluded glens on either side of the river as winter night roosts (Dunstan, Mathisen, and Harper 1975), however, we were unable to locate any such areas.

More total sightings were made in 1980 than in 1979 (77 as compared with 41), and in spite of the fact that 280 hours were spent in the field in 1980 to 193 hours in 1979, the overall frequency of sightings was greater in 1980

Figure 53. Locations of favored artificial fish perches in the Sault Ste. Marie area.

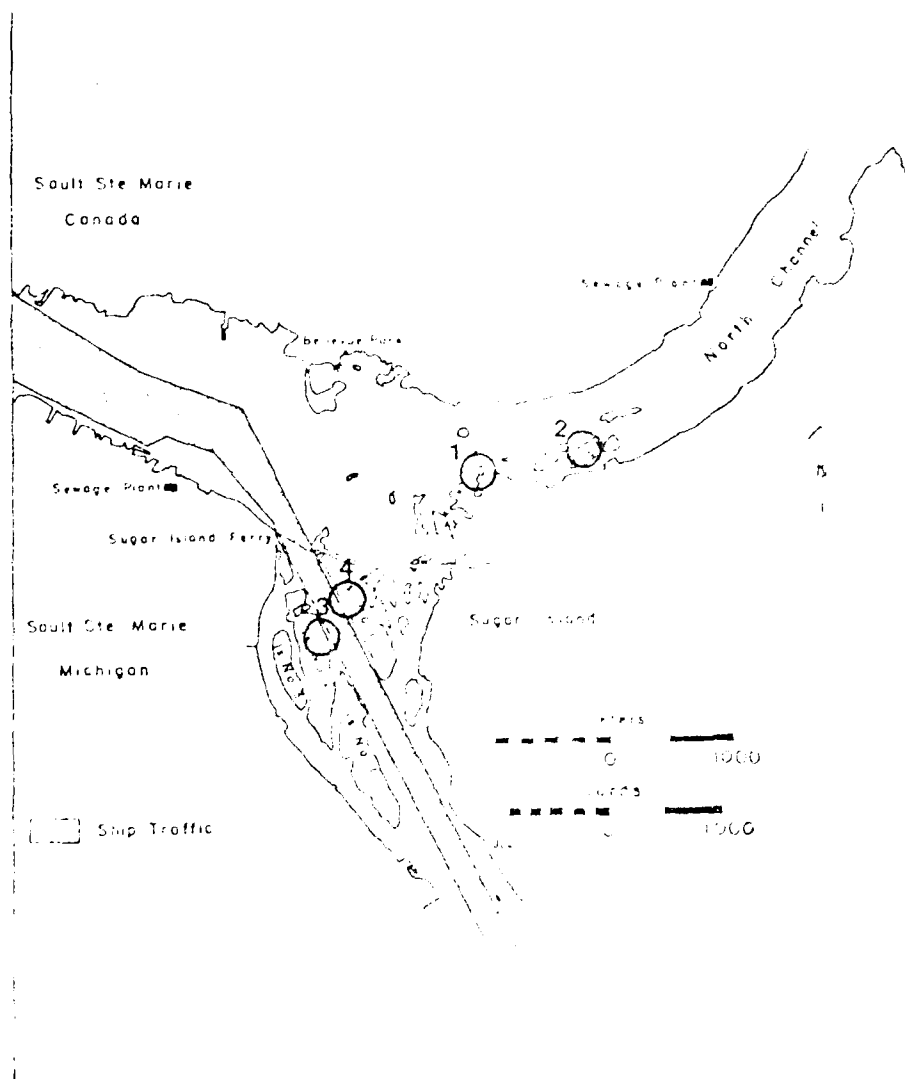




Figure 54. Aerial view of eagle perch island (Perch "1"). Small island at right center surrounded by a crescent shaped area of open water. 10 March 1979.



Figure 55. Aerial view of Perch 1. 13 February 1979.

Table 7. Eagle Sightings per Hour of Effort, 1979. Number of Hours of Effort is Given in Parentheses.

Time of Day (EST)	January	February	March	April	1979 Overall
0600-0700	0(0)	0(0)	0(0)	0(2)	0(2)
0700-0800	0(1)	0(1)	0(0)	0(2)	0(4)
0800-0900	0(1)	0(1)	0(3)	0(2)	0(7)
0900-1000	0(2)	0.50(6)	0(2)	0(2)	0.17(12)
1000-1100	0.17(6)	0.50(8)	0(3)	0(7)	0.21(24)
1100-1200	0.22(9)	0.57(7)	0.20(5)	0.50(6)	0.37(27)
1200-1300	0.40(5)	0.36(11)	0.10(10)	0(5)	0.23(31)
1300-1400	0.28(7)	0.54(11)	0(7)	0(3)	0.29(28)
1400-1500	0.20(5)	0.57(7)	0(5)	0(5)	0.23(22)
1500-1600	0.20(5)	0(5)	0.20(5)	0(3)	0.12(16)
1600-1700	0(5)	0(4)	0(6)	0(0)	0(15)
1700-1800	0(3)	0.20(5)	0(5)	0(1)	0.07(14)
1800-1900	0(1)	0(6)	0(3)	0(2)	0(12)
Overall	0.20(46)	0.38(69)	0.06(46)	0.09(32)	0.21(193)

Table 8. Eagle Sightings per Hour of Effort, 1980. Number of Hours of Effort is Given in Parentheses.

Time of Day (EST)	January	February	March	April	1980 Overall
0600-0700	0(1)	0(0)	0(11)	0(0)	0(12)
0700-0800	0(2)	0.67(3)	0.18(11)	0(0)	0.25(16)
0800-0900	0(2)	0.50(4)	0.36(11)	0(0)	0.35(17)
0900-1000	0.75(4)	0(1)	0.58(12)	0(1)	0.56(18)
1000-1100	0.40(5)	0(3)	0.20(15)	0(2)	0.20(25)
1100-1200	0.62(8)	0.40(5)	0.36(14)	0(3)	0.40(30)
1200-1300	0.11(9)	0.33(3)	0.15(13)	0(4)	0.14(29)
1300-1400	0.90(10)	0(5)	0.20(15)	0(4)	0.35(34)
1400-1500	0.67(6)	0.57(7)	0.07(14)	0(2)	0.31(29)
1500-1600	0.40(5)	0.40(5)	0.36(14)	1.00(1)	0.40(25)
1600-1700	0(6)	0.25(4)	0(10)	0(1)	0.05(21)
1700-1800	0(7)	0.20(5)	0.12(8)	0(1)	0.10(21)
1800-1900	0(1)	1.00(1)	1.00(0)	0(0)	0.67(3)
Overall	0.39(66)	0.35(46)	0.20(149)	0.05(19)	0.28(280)

(0.28/hour in 1980 to 0.21/hour in 1979). This difference however, is not statistically significant ($\chi^2=2.07$, $p>0.10$). Table 9 is a comparison between 1979 and 1980 of the numbers of times eagles were sighted in flight with the numbers of times they were sighted perched. Eagles were seen in flight significantly more often in 1980 than in 1979 ($\chi^2=5.57$, $p<0.05$). This suggests that the birds may have been less active in 1979 (possibly due to extremely cold weather) which might also account for the lower frequency of sightings in 1979.

Another possibility is that the eagles were spending more time away from the ship channel in 1979 due to ship traffic and were therefore less easily observed. Table 10 compares the numbers of times eagles were seen within 1/2 mile (0.8 km) of the ship channel (as designated on earlier maps showing open water conditions) with the numbers of times they were seen more than 1/2 mile (0.8 km) from the channel. Percentages are shown in parentheses. There is no statistically significant difference between the distance from the channel of flying birds ($\chi^2=1.63$, $p>0.20$), indicating that the eagles were apparently not averse to flying near the channel in spite of ship traffic. Eagles were, however seen perched significantly more often near the channel in 1980 than in 1979 ($\chi^2=10.02$, $p<0.01$). This could indicate that winter navigation had an influence on where the eagles perched during the winter. However, other factors such as the severe weather conditions as noted in 1979 could also account for this behavior. (See below)

Metabolic rate and oxygen consumption of birds increase as the ambient temperature drops below the birds' thermoneutral zones (Welty 1975). The thermoneutral zone has not been defined for eagles, however. Because heat dissipation is less for larger birds than for smaller ones by virtue of their smaller surface to volume ratio (Calder and King 1974), it may be that a bird as large as an eagle could remain inactive and withstand colder temperatures than a smaller bird. This could explain the seemingly lower 1979 activity levels of the eagles.

Metabolic rates of birds while flying and resting have been compared (Farner 1970). The rate during flight varies from 2 to 15 times that during rest. These measurements, however were made on birds much smaller than eagles. The ratio of the flying metabolic rate (FMR) to resting or standard metabolic rate (SMR) seems to be more dependent on how rapidly the bird flaps during flight than on size. It may be assumed that eagles which depend a good deal on soaring and gliding and are not strong flappers would have a fairly low FMR/SMR ratio. Even so, the FMR must still be higher than the SMR, even at very cold temperatures. Even though more heat is generated by flying, it is also dissipated faster during flight. The saving of energy by remaining perched during very cold weather may outweigh the benefits of flying to obtain food, at least for short periods.

Eagle Home Range. Judging from sightings made, the shaded area in Figure 56 is believed to constitute the winter home range of the eagles wintering on the study area. The range may be larger, as the eagles are capable of easily covering great distances. Nye (personal communication) stated that while the home range of eagles wintering in southeast New York

Table 9. Comparison of the Number of Times That Eagles Were Sighted Flying or Perched in 1979 and 1980.

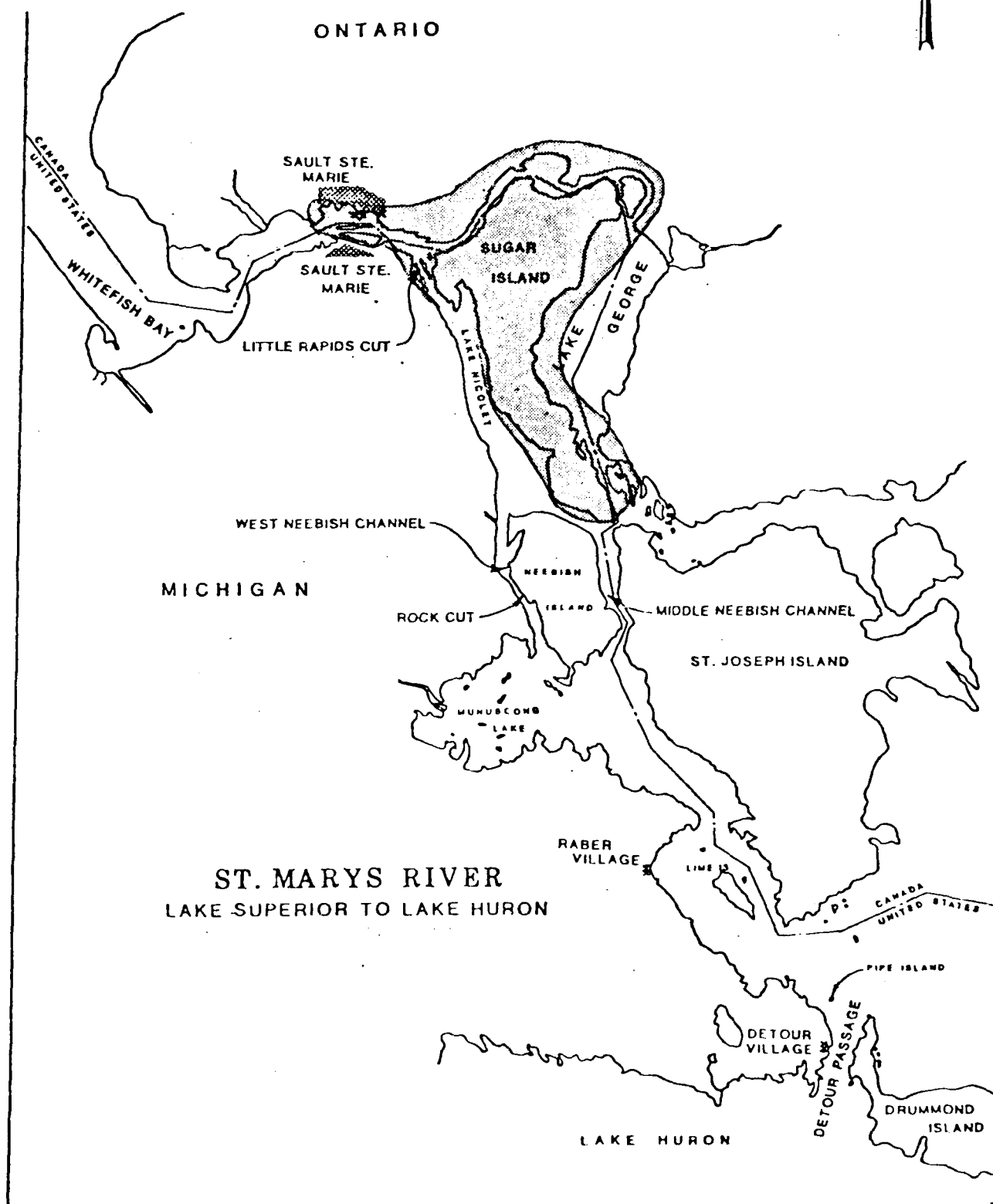
Year	Activity When Sighted	
	Flying	Perched
1979	7	34
1980	38	46

Table 10. Number of Times Eagles Were Observed Within 1/2 Mile (0.8 km) of, and More Than 1/2 Mile (0.8 km) From the Ship Channel.

Year	Sightings Flying	
	Within 1/2 Mile	More Than 1/2 Mile
1979	6(86%)	1(14%)
1980	22(71%)	9(29%)

	Sightings Perched	
	Within 1/2 Mile	More Than 1/2 Mile
1979	1(3%)	33(97%)
1980	16(35%)	30(65%)

Figure 56. Estimated eagle winter home range on the St. Mary's River.



was generally about 20 km long and half as wide, one radio-tagged eagle was known to travel up to 45 miles (75 km) in one day. The majority of the open water on the St. Mary's River study area lies within the bounds of the shaded portion of the map. The eagles may be expected to remain fairly close to the open water.

Eagle Food Habits. Eagles were observed actually feeding only once in 1979. That occasion was in late December, when an eagle was seen on the ice eating what was believed to be a merganser (Tom Weise, biologist with the Michigan Department of Natural Resources, personal communication). Eagles were seen securing food on only two other instances that year. In 1980, eagles were seen feeding on four occasions. Also evidence (blood, feathers, and eagle tracks) of an eagle having killed a raven were discovered at a feeding site, although the event was not actually witnessed. Each case of an eagle eating or securing food is summarized in Table 11 and the locations plotted on Figure 57.

Primary winter eagle food sources are fish and waterfowl, as cited earlier (Lerg 1979; Owen and Todd 1979); however, the birds are opportunistic and will feed on available carrion (Southern 1964) as was the case with the deer carcass at the south end of Sugar Island. The proportion of the eagles' diet made up by each of these three food sources is unknown. Owen and Todd (1979) reported that diet varies with habitat and season. On the Maine coast, avian prey (up to 50% black ducks and gulls) are the primary food source for eagles in winter. The greatest reliance on fish (only about 35% of the diet) occurs in summer. While fish, waterfowl, and carrion were all noted to be eaten by eagles on the St. Mary's River study area, the small number of observations makes it impossible to determine which is most important.

Eagle Capture Attempts. In order to gain a fuller knowledge of the eagles' habits and movements, and to discover if the birds wintering there also nested there, attempts were made in February and March 1980 to capture and place a radio transmitter on one or both eagles. Several trapping techniques were tried (see Methods), and even though it was fairly certain that the eagles were aware of our bait (they were seen circling directly over the deer and duck carcasses at an altitude of about 20 m, Figure 58), all of our attempts failed. We included all three of the known eagle food sources (fish, waterfowl, and a deer carcass) in our trap methods, but do not know why the eagles refused to be lured in. It may be that there was some aspect of the traps that made the eagles wary, or that enough food was available elsewhere that they did not need to take advantage of the food offered by our lures.

Other Raptors

Other raptors seen on the study area included one gyrfalcon (*Falco rusticolus*), one goshawk (*Accipiter gentilis*) (mentioned earlier), two red-tailed hawks (*Buteo jamaicensis*), and a great gray owl (*Strix nebulosa*).

Table 11. Summary of Observations of Eagles Feeding in the Winters of 1978-79 and 1979-80. Observation Numbers Correspond with Numbers in Figure 57.

Observation Number	Date	Food Item	Location	Comments
1	31 Jan. 1979	Fish (spp. unknown)	Between Island #1 and Sugar Island.	Eagle flying south with fish in talons.
2	(?) 1979	Mallard	Between Island #1 and Michigan mainland.	Duck taken in flight. Report by local observer.
3	23 Dec. 1979	Merganser (?)	South of Little Rapids Cut.	Eagle on ice with kill. Reported by Tom Weise.
4	21 Jan. 1980	Deer carcass	South end of Sugar Island.	Eagle seen flying from carcass by Todd Fuller.
5	21 Jan. 1980	Raven	South end of Sugar Island.	Eagle and raven tracks, blood, and feathers suggest eagle killed raven feeding on carcass.
6	31 Jan. 1980	Hen mallard	Mid-river ice north of Sugar Island Causeway.	Examination of remains on Feb. 1 gave conclusive ident. of food item.
7	16 Feb. 1980	Unknown	Ice off mouth of Garden River, North Channel.	Spotted from plane. Remains too near open water for examination.
8	19 Feb. 1980	Fish (spp. unknown)	Mid-river north of Sugar Island Causeway.	Fish snatched from open water, eaten on the ice.

Figure 57. Locations of eagle feeding sights during the winters of 1978-79 and 1979-80.

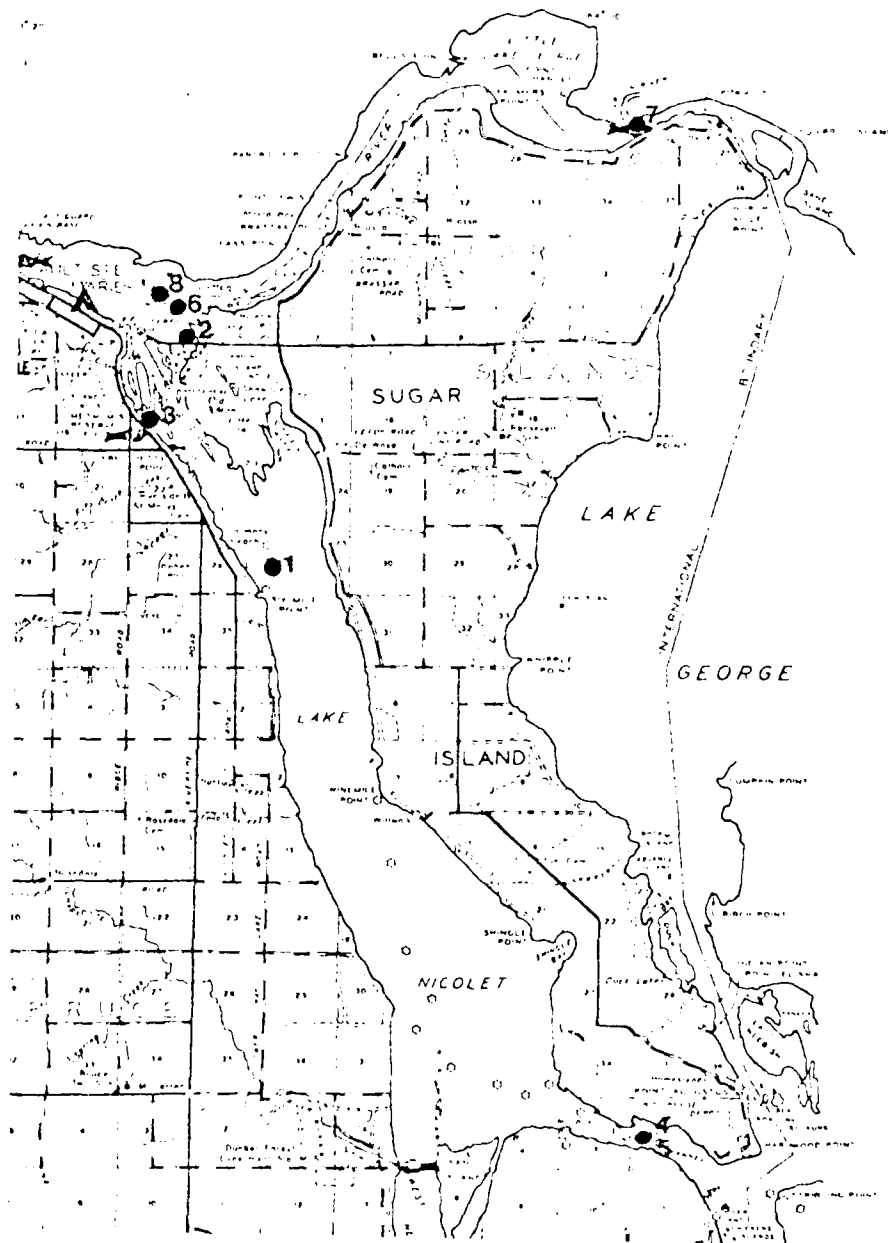




Figure 58. Adult bald eagle circling over the main channel near the head of the Little Rapids Cut. 14 March 1980.

The gyrfalcon was observed on 23 January 1979 attempting to capture goldeneyes as they flew to roost at the Edison Soo Hydro outfall in the evening. Four attempts failed. As the falcon came within 1/2 m of striking a flying duck, the goldeneye would fold its wings and dive into the water to escape. The falcon made no attempt to capture ducks already in the water.

Two red-tailed hawks were seen near the river in 1980. None had been seen in 1979 until mid-April. One of the red-tails seen on north Sugar Island on 5 February 1980, was immature. The other was an adult seen on St. Joseph's Island on 9 February. Red-tailed hawks are not believed to be dependent on the river, as are the eagles.

The great gray owls (at least 6 were reported by some observers) were found on Neebish Island throughout the winter of 1979. While having no apparent direct connection with the river, they (along with a lone male harlequin duck) served as an attraction for large numbers of "birders" from as far away as New Jersey. One great gray owl was captured and banded on Whitefish Point on 19 April 1980.

Impacts of Ships and Humans on Eagles

Direct Effects. There is not enough evidence to indicate any direct effects of vessel passage on eagle behavior. We did not witness any clear examples of eagles being flushed by ships. On only two occasions we were able to observe eagles perched less than 3/4 mile (1.2 km) from the ship channel when cargo vessels were in the vicinity. The first of these was on 16 February 1979, when an eagle was perched on a rock dredged island at the center of the river outside the Sault, Michigan sewage treatment plant. The upbound ore carrier Stinson was just about to clear the Little Rapids Cut (about 1/2 mile downriver) when the eagle suddenly left its perch, flew a short distance upriver, and then flew east down the North Channel and out of sight. All this time, the second eagle remained in a tree on Perch 1 Island (Figure 53) 3/4 mile (1.2 km) from the nearest point of ship passage.

The second instance took place on 13 January 1980. An eagle was perched on Perch 1 island. As the downbound ore carrier Roger Blough entered the Little Rapids Cut, the eagle left the perch 3/4 mile (1.2 km) from the ship and flew upriver to join its mate on the ice near the Sault, Michigan sewage treatment plant. It is unclear whether the ship (which was moving very slowly and quietly) flushed the bird.

While no cargo vessel traveled the river from 15 January to 24 March 1980, the Sugar Islander Ferry continued to make its scheduled hourly and half-hourly crossings. Eagles were often seen perched less than 300 meters from the ferry landing in 1980. It is likely that the eagles have become accustomed to the ferry and local automobile traffic and are not disturbed by it. This type of activity is both frequent and regular, whereas, cargo ships are much larger and pass on irregular schedules. It should also be mentioned that the eagles paid little or no heed to our airplane, even when circling passes were made, sometimes at distances of less than 100 meters from the birds.

Stalmaster and Newman (1978) showed that bald eagles along the Nooksack River in Washington flushed from humans as a range of up to 500 meters, however, eagles vary in their sensitivity to human disturbances (Postupalsky, personal communication). We observed eagles being disturbed by humans on two occasions. On 13 January 1980, just after the Blough's passage mentioned above, a group of observers walked toward the river's edge just south of the Sault, Michigan sewage treatment plant to see where the eagle seen earlier had gone. Both eagles were sitting on the shore ice below the bank and were hidden from view. Both birds flew instantly as the observers approached, at a distance of less than 50 meters. The second incident took place on 4 February 1980 when Robinson and Jensen observed an eagle perched on Hog Island (Perch 2 in Figure 53). As we approached the river's edge, some 300 meters from the bird, it took flight and slowly soared up out of view. The eagles appeared quite sensitive to human activity, when people were not in houses or vehicles or at regularly frequented locations.

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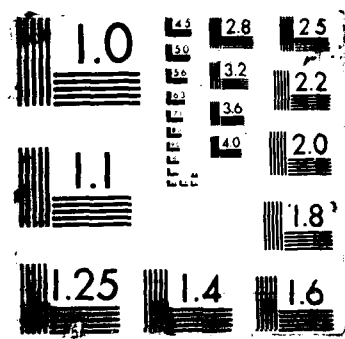
EFFECTS OF WINTER NAVIGATION ON WATERFOWL AND RAPTORS
IN THE ST MARY'S RIVER AREA(U) NORTHERN MICHIGAN UNIV
MARQUETTE DEPT OF BIOLOGY W L ROBINSON ET AL SEP 88
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Potential Effects. As mentioned earlier concerning waterfowl, an impact on eagles which has not been encountered, but is potentially serious is the spillage of oil or some toxic substance into the river. Eagles, which depend largely on the aquatic food chain, would be adversely affected by such a spill, especially if it occurred in the upper portion of the river. The extent of the impact is difficult to assess and would depend on several conditions, however for eagles, which will eat dead or dying waterfowl and fish. Consumption of a contaminated animal could be very dangerous, possibly resulting in eventual death of the bird or in reproductive failure.

EFFECTS OF ICE BOOMS AND BUBBLERS

The ice boom and bubbler at the head of the Little Rapids Cut are of some benefit to waterfowl (especially mergansers) through the maintainance of open water in that area. There are often up to 8 to 10 ducks feeding or resting there. We feel that placement of bubbler systems at isolated locations on the river, such as at Johnson Point, would be of little or no benefit or harm to waterfowl, as ducks rarely use the isolated, naturally open water pools that exist in the central section of the river.

It is unlikely that bubblers or booms would be beneficial to eagles. Eagles have never been seen feeding at known bubbler or ice boom locations. Bubbler-maintained open water would therefore be of little value to the eagles, and the bubblers would likewise in themselves, be of little harm.

CONCLUSIONS AND RECOMMENDATIONS

IMPORTANT AREAS

Waterfowl

For the mallards, black ducks, and Canada geese, Bellevue Park and the adjacent open water areas 3-5 km on either side of the park along the Canadian shore are important winter areas. For the common goldeneyes and common mergansers, the areas considered important are: the St. Mary's Falls area, the Edison Soo Hydro outfall, and any areas open in the North Channel, along the Canadian shore through the city and including the Sault, Ontario sewage treatment plant. These areas are shown on the maps of Figures 59 and 60.

Those locations regarded as important winter waterfowl habitat are considered so first because of their open water, and second for their food supplies. Night roosts are important in that they remain open during cold evening temperatures when waterfowl activity is at a minimum, and in that they afford some protection from inclement weather. Most of the winter areas frequented by ducks on the St. Mary's River are kept open by natural currents or by human influences, such as steel production, power production (Figure 61), or sewage disposal, and only to a minor degree by winter shipping activities.

Since waterfowl used the the ship channel in 1980 but did not in 1979, the question remains as to whether or not the channel should be considered important habitat. Although there was no apparent duck mortality in 1979, deprivation of feeding in the channel area could have had physiological effects on the diving ducks. Hartman (1963) found that black ducks deprived of normal winter feeding areas by ice cover in a two-week period showed signs of malnutrition, short of mortality, including lack of subcutaneous fat and general weight loss. Winter weight losses could be reflected in reduced egg production and viability of eggs (Bennett and Bolen 1978).

Collection of goldeneyes and mergansers, and sampling of food items on the study area would be necessary to determine the absolute importance of the ship channel as important winter habitat for these species.

Raptors

The bald eagle and the snowy owl were the only raptors which appeared

Figure 60. Important areas for wintering waterfowl at Sault Ste. Marie.

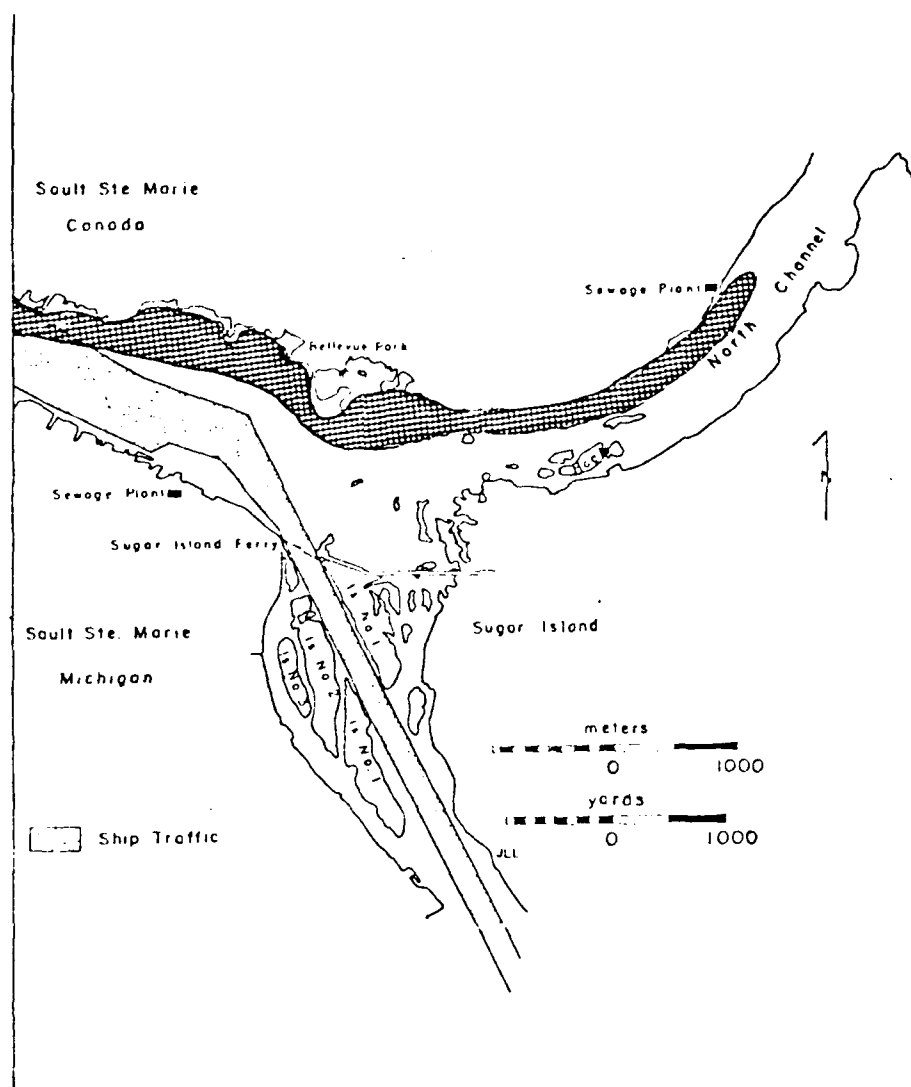


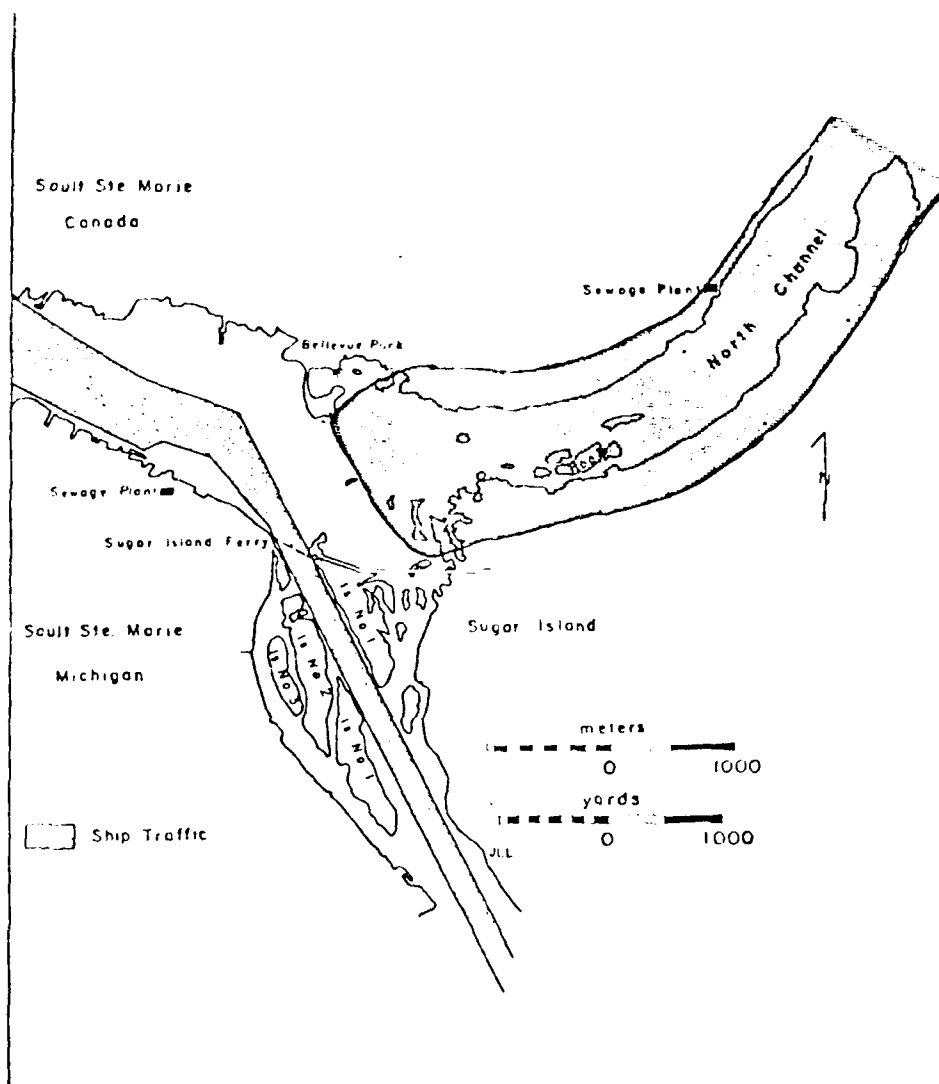


Figure 61. Sault Ste. Marie, Ont. Algoma Steel Corporation (background) produces warm water effluent.

consistently during both study seasons. The owls did not seem to be heavily dependent on the river since their appearances were rare and unpredictable. The eagles on the other hand, seemed to be directly dependent on the river for the bulk of their food supply.

The shaded area in Figure 62 includes the portion of the study area where eagles were seen consistently during both winters, and must therefore be considered of significant importance. However, virtually the entire area shown in the map, (along with the rest of the eagles' home range) especially the Little Rapids Cut region and upriver from there, could also be considered important, even though the eagles survived the winter of 1978-79 without using these areas often.

Figure 62. The area frequented by eagles during both winter study seasons (1978-79 and 1979-80).



RECOMMENDATIONS

1. Continue the condition of no winter shipping between 1 January and 31 March for at least two more consecutive winters, and conduct studies to obtain a more representative baseline picture of waterfowl and raptor populations and behavior.
2. Studies under such conditions should be designed to obtain the following information:
 - a. Numbers and species of waterfowl present.
 - b. Behavior of waterfowl relative to the location of the ship channel.
 - c. Food habits of goldeneyes and mergansers.
 - d. Duck food availability by month and location, especially with regard to location of the ship channel.
 - e. Physical condition of goldeneyes and mergansers with progress of the winter.
 - f. Numbers of eagles present.
 - g. Behavior of eagles relative to the location of the ship channel.
 - h. Detailed information on hourly movements and home range of eagles through radio telemetry.
3. If a decision is made to ship during any dates between 1 January and 31 March, comparable information to that outlined in Point 2 above should be gathered.
4. If a decision is made to proceed with winter shipping, we recommend the following (based upon information obtained during the winters of 1978-79 and 1979-80):
 - a. Keep ship traffic (in the home range of the eagles) to a minimum between the hours of 0900 and 1600, the time when eagles most commonly frequent the river near the shipping channel.
 - b. Keep ship traffic in that area on a regular schedule, so that eagles can become accustomed to the routine.
 - c. Run ships slowly through the channel with a minimum of engine noise and whistles. This would reduce disturbance to both eagles and waterfowl.

- d. Maintain normal flow of water through the St. Mary's Falls (Rapids) to ensure the preservation of this important duck feeding area.
- e. Restrict ship traffic in the Sault Ste. Marie area to the channels now used in winter, and restrict use of the Canadian half of the river and the North Channel of Sugar Island. Open water in these areas now serves as a refuge for ducks and feeding ground for eagles. Regular use of these areas for winter shipping would likely have a serious impact on these birds.
- f. Institute every possible control to prevent spillage of oil or toxic materials, as no clean up strategy is adequate, and spillage could have a disastrous effect on both waterfowl and eagles.

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APPENDIX 1

Ground locations from which regular observations were made.

SAULT STE. MARIE, MICHIGAN

Shallows (3 miles west of locks)
Power canal inlet
Edison Soo Hydro Plant
Elks Club Parking lot (1/2 mile below hydro plant)
Sugar Island Ferry Crossing
Moose Lodge Parking Lot (1/4 mile below Sugar Island ferry)
Three Mile Road on Riverside Drive

SAULT STE. MARIE, ONTARIO

Algoma Steel Coolant Pond
St. Mary's River Rapids (from Whitefish Island)
Lamprey Control Center
Holiday Inn - Civic Center Area
General Hospital Parking Lot
Great Lakes Center for Forest Research
Bellevue Park
Sault Ste. Marie Country Club Parking Lot
Sault Ste. Marie Sewage Treatment Plant

NEEBISH ISLAND ROCK CUT and FERRY CROSSING

DeTOUR VILLAGE, MICHIGAN

Two points within the village, a boat yard and a water treatment facility
Docks one mile upriver at abandoned coal refueling facility

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